International Journal of Trend in Scientific Research and Development (IJTSRD)
Volume 6 Issue 7, November-December 2022 Available Online: www.ijtsrd.com e-ISSN: 2456 – 6470

Effects of Active Learning Strategies in Teaching Physics

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ABSTRACT

The study utilized a quasi-experimental method of the pretest-posttest design with the pre-selected groupings for the control and experimental groups. The study used validated researcher-constructed pretest-posttest questionnaires, online distance learning plans, attitude surveys, and focus group discussion questionnaires to determine the students' performance. The study was conducted at a private high school in Cebu City. Both experimental and control groups underwent a pretest before implementing the proposed interventions.

The study's findings showed the following results: (a) both control and experimental groups manifested Above Average performance in the pretest and posttest; (b) there was a significant mean improvement in the student's performance in Physics in both experimental and control groups; (c) there was no significant difference in the mean improvement in Physics between the experimental and control groups, and (d) the experimental group showed a very positive level of attitude towards the use of active learning strategies in teaching Physics.

Based on the findings of the study, the integration of active learning strategies to the group with less teacher presence (acts only as facilitator) proved to be as effective as the group who received explicit teaching from the teacher in teaching Physics. In addition, it did not only enhance the students' performance as manifested by their comparable performance with the other group but was also influential in developing a positive attitude that affected their performance. The theories of Direct Instruction by Siegfried Engelmann and Douglas Carnine believe that teacher-centered teaching strategies are effective in teaching Physics since the teacher explicitly teaches and helps the students understand the lessons. Constructivism Learning by Jean Piaget states that involving the students actively and exposing them to activities that will engage them in the teaching and learning process by interacting with their actual experiences were confirmed by this study's findings.

The study advises curriculum designers to provide several active learning activities that encourage student engagement and participation and apply dynamic teaching techniques in Physics instruction. Additionally, to help them overcome the challenge, students should be offered various learning methodologies, and future researchers should conduct a comparative study on face-to-face training.

How to cite this paper: Nikko C. Catarina "Effects of Active Learning Strategies in Teaching Physics" Published in International Journal of Trend in Scientific Research and Development (ijtsrd), ISSN: 2456-6470, Volume-6 | Issue-7, December 2022, pp.1336-1354, URL: www.ijtsrd.com/papers/ijtsrd52598.pdf

IJTSRD52598

KEYWORDS: *active learning strategies; physics teaching; work; energy*

THE PROBLEM AND ITS SCOPE

Rationale

Since antiquity, Science has evolved in-depth and breadth as a body of knowledge. One could argue that science, along with our curiosity and desire for truth, comes easily to people of all ages and backgrounds.

Science education is one of the most critical subjects in school due to its relevance to students' lives and the universally applicable problems it uses (Contant et al., 2018). According to O'Keeffe (2018), physics is one of the most fundamental natural sciences since it aims to understand how nature employs mathematics. It features a lot of abstract notions that are difficult for students to fathom.

Although the subject covers real-world concepts, many find the course content more difficult to comprehend and understand since it includes most theoretical concepts and rigid mathematical calculations (Ekici, 2016). The content of the subject matter, appropriate teaching methods and tactics utilized in the learning materials, classroom atmosphere, and teacher factor were all factors that contributed to the difficulty in Physics, according to Camaro et al. (2017). As a result, teachers should employ a teaching method appropriate for the learner.

Science teachers face the challenge of employing better methodologies and activities to make it more interesting. Teaching Science, particularly in high school, is difficult because of the more complicated theories. Aside from it, experiments require careful planning and preparation. Additionally, the COVID-19 pandemic has forced Science teachers to become more creative, resourceful, and innovative (Arrieta et al., 2021). For such reasons, science education teachers generally urge more innovative approaches to teach and learning science. Without introducing change and innovations and adopting the current situation we are facing, our educational systems cannot meet the challenges and solve the problems of modern society (Olagunju et al. 2003).

Nowadays, the active learning strategy is one of the most extensively employed teaching strategies in academia today. Active learning is any teaching method that involves students in meaningful activities that reflect what they are learning in the teaching and learning process (Bonwell & Eison, 1991). While this concept may include traditional activities such as homework, in practice, active learning encompasses demonstrations, group work, and other activities (Prince, 2004). In other words, the degree of student involvement in the teaching process distinguishes active learning from other types of learning.

Additionally, this teaching strategy improves students learning, teaching, and communication skills (Kalem and Fer, 2003), allows students to actively create and construct knowledge (Carr et al., 2015), and develop attitudes and values through immersive discovery (Sivan et al., 2000; Suwondo dan Wulandari, 2013; DeWitt, 2003).

Based on the data cited above, it seems that active learning strategies could help improve and enhance students' performance and attitude, particularly in teaching Physics. However, upon reviewing the relevant literature, it was revealed that there are limited literacy citations and knowledge of active learning and its usefulness in teaching Physics principles, particularly in the areas of work and energy.

Thus, the researcher would like to investigate the effectiveness of active learning strategies in teaching work and energy Physics concepts.

The Problem

Statement of the Problem

This study determined the effectiveness of Active Learning Strategies in teaching Physics among Grade 9 students. Specifically, this study aimed to answer the following questions:

1. What is the pretest-posttest performance in Physics of the Grade 9 students in the:
   - 1.1. Control group (exposed to Online Distance Learning Plan without active learning strategies) and;
   - 1.2. The experimental group (exposed to Online Distance Learning Plan with active learning strategies)?
2. Is there a significant mean improvement in Physics performance from the pretest to the post-test of Grade 9 students in the:
   - 2.1. Control group (exposed to Online Distance Learning Plan without active learning strategies) and;
   - 2.2. The experimental group (exposed to Online Distance Learning Plan with active learning strategies)?
3. Is there a significant difference in the mean improvement in Physics performance between the control group and the experimental group?
4. What is the level of attitude of the experimental group toward the use of active learning strategies in teaching Physics?

Hypotheses of the Study

To answer the problems in the study, the following null hypotheses were tested:

H_{01}: There is no significant mean difference between the hypothetical mean and the actual mean of the

Grade 9 students in the pretest and posttest results in Physics of the:

1.1 control group (exposed to ODLP without active learning strategies) and;
1.2 the experimental group (exposed to ODLP with active learning strategies).

H_{02}: There is no significant mean gain in the Physics performance from the pretest to the post-test of the Grade 9 students in the:

2.1 control group (exposed to ODLP without active learning strategies) and;
2.2 the experimental group (exposed to ODLP with active learning strategies).

H_{03}: There is no significant difference in the mean gain in Physics performance between the control group and the experimental group.

Theoretical Background

Related Theories

The study is anchored on the **Direct Instruction Theory** (Siegfried Engelmann and Douglas Carnine, 1980, 1999) and the **Constructivism Learning Theory** (Piaget 1972) to support the claims presented.

Direct Instruction Theory by Siegfried Engelmann and Douglas Carnine. (1982) believe that if a student does not understand something, the teacher is not teaching well. When it comes to direct education, this is a common occurrence: the teacher is always the source of knowledge within the four walls of the classroom. Through practical lessons, corrective feedback, and practice opportunities, this instructional technique, also known as explicit teaching, requires the teacher to keep the students engaged in class.

According to Adams and Carnine (2003), the teacher is in charge of the students' education; he or she must always keep the students' attention focused on him or her. Teacher-directed or teacher-led instruction describes a theory or teaching approach in which the teacher is in charge of all instructional decisions. However, as time goes by, the idea of this theory has evolved, Magliaro et al. (2005) emphasize that this form of instruction is suitable for the design of technology-enhanced and technology-based instruction because it has a clear framework and the capacity to provide learners with opportunities for practice and immediate feedback.

Furthermore, according to Freiberg & Driscoll (2000), it is an instructional approach that focuses primarily on the teaching and learning process, with time and control being the two most essential advantages; hence, in this study, this is used as an anchor for the ODLP without integration of active learning strategies which will be applied to the control group.

Meanwhile, one of the most utilized teaching methods is the active learning strategy, which allows students to participate in meaningful and reflective activities (Bonwell and Eison, 1991). Thus, this active learning strategy is aligned with the Constructivism Learning Theory.

Constructivism Learning Theory by Piaget (1972) proposes that humans produce knowledge by interacting with their experiences and ideas, and the individual is at the heart of the knowledge generation and acquisition process. On the other hand, Mascolo and Fisher (2005) explain that this theory believes that knowledge is best gained through active mental construction and involvement, making knowledge an intersubjective interpretation. As a result, to take responsibility for their actions, students must be taught to broaden their perspectives and express their points of view (Andanga and Purwarno, 2018). According to Fernando and Marikar (2017), this theory must emphasize three ideas during the teaching and learning process: 1) learning is an active experience; 2) students' ideas about the subject and topic being taught will be a part of their learning experience, and 3) learning is rooted in social and cultural contexts. Bransford et al. (1999) believe that teachers should design learning activities that allow students to confront misconceptions, allowing them to reconstruct their mental models based on more accurate understanding. As a result, this theory supports the notion that teachers should use a variety of active learning tactics in the classroom to encourage students' active learning participation and aid in the acquisition of new knowledge; hence, in this study, this is used as an anchor for the ODLP with active learning strategies which will be applied to the experimental group.

Related Literatures

Teaching education is a process wherein a teacher plans and organizes for students to learn more effectively by choosing a teaching approach or method appropriate for the lesson's subject (Ahmed, R. 2004). In recent years, education experts in the academe have undertaken innovations such as new teaching approaches and techniques, focusing on developing 21st-century students' vital skills and abilities. (Partnership for 21st Century Skills, 2008).

Science and technology are essential contributors to our country's progress, making us realize how crucial it is to grasp how it works and how it should be taught to students. Because scientific education comprises numerous abstract concepts that students might acquire through various methods, Driver et al. (1994) feel that teachers should adopt an appropriate teaching strategy to ensure that effective teaching occurs. Within the past years since the pandemic, it has been challenging to adapt an online instructional strategy that is more in line with the intensity of a face-to-face classroom approach since the science standards encourage an inquiry-based approach (Miller, 2008).

Nowadays, it is evident that teaching Physics education is facing a significant challenge in finding the appropriate learning strategies and methodologies that can be used in the teaching and learning process due to the pandemic we are experiencing today. Despite calls for a suspension of classes due to the coronavirus outbreak, the Department of Education feels that education should not be harmed. The government used this to develop an online distance-learning strategy. The term "online distance learning" refers to a teaching approach in which students and teachers are physically separated. The learning process occurs entirely on a computer or other device that can access the internet (Western Cooperative for Educational Telecommunications, 2004).

Synchronous sessions, in which students participate in real-time learning, such as a web conference or a student-to-student chat room, are examples of online distance learning. Asynchronous online distance learning, on the other hand, allows students to process information at their own pace and digest their knowledge independently of others and at their own pace. Blended learning is when traditional classroom learning is combined with online or e-learning (Browne, Jenkins & Walker, 2006).

In teaching Physics in an online setting, we can arguably say that one of the essential topics that need to be covered are energy and work, which is the focus of this study, wherein some of the students find it intriguing and challenging to understand even though it is one of the most basics topics in Physics education. Warren (1991) argues that students have difficulty understanding work and energy from the perspective of physics and their daily activities and that energy is an abstract mathematical concept.

Today, almost every educator can relate to the fact that students do not pay attention during a presentation during this pandemic (Bunce et al., 2010). In light of this notion, teachers must be able to keep students interested for extended periods, especially in an online learning environment, to make the topics more enjoyable and deliver them with clarity, enthusiasm, and occasional cognitive breaks (Bligh, 2000).

Active learning strategies can be any pedagogy that encourages students to actively participate in class activities such as answering questions, resolving problems, and discussing solutions with peers. (Weiman, 2014). On the other hand, Felder et al. (2009) explain that it consists of a short course-related individual or small-group activities that all students in a class are required to complete, alternated with instructor-led intervals in which student responses are processed, and new information is presented.

According to the National Survey of Student Engagement (NSSE) and the Australasian Survey of Student Engagement (AUSSE), active learning can be defined as "students' efforts to construct their knowledge actively." The AUSSE attempts to measure active learning by developing the students' efforts to construct their knowledge by working with other students on projects in class, making a presentation, asking questions or contributing to discussions, and participating in a community-based interaction (reported in Carr et al., 2015).

Additionally, Livingstone and Lynch (2003) believe that in the active learning process, students shift from passive recipients of knowledge to active participants in activities involving analysis, synthesis, and scientific assessment while also developing skills, values, and attitudes. On the other hand, Kalem and Fer (2003) explain that discussions conducted utilizing active learning approaches benefit learning, teaching, and communication.

As a result, "active learning" is commonly used to describe the practices students engage in to improve their understanding of the subject. The tasks vary, but they all require students to think at a higher level of abstraction. Even if it is not often explicitly acknowledged, metacognition, or how pupils think about their learning, is a critical component that connects action and learning.

Johnson & McCoy (2011) believes that instead of passively acquiring information through a lecture format, students can use the active learning process to uncover concepts on their own and develop frameworks with a more long-term structure. Additionally, one reason that active learning is thought to be so successful in improvements for student achievement and knowledge is that it increases metacognition. Metacognition is awareness of one's thought processes or the learning process. If students are cognizant of what they are learning, they are engaged in higher-ordered thinking and will make better connections between old material and new material.

On the other hand, Suwondo dan Wulandari (2013) adds that active learning methods of teaching can improve students' attitude toward school and learning in general because they allow them to improve their scientific attitude, cultivate the fundamentals of scientific thinking in students, and generate their creativity in solving problems.

Furthermore, Price (2004) points out that students' attitudes and understanding increase due to active learning because the goal is to create a balance between lecturing and active learning approaches rather than never lecturing again. Both of these methods allow teachers to go over what they need to in order for their students to fully comprehend what they are learning while also addressing fundamental misconceptions, as it allows misconceptions to arise naturally during the learning process and able to recognize and correct their mistakes, resulting in better retention of information and a deeper understanding.

As cited by DeWitt (2003), students can explain science topics in simple terms if they use active online resources or actively participate in the class. These principles align with the active learning method employed in the classroom, demonstrating that it can engage students and change their attitudes about science and learning. Consequently, there are numerous advantages to using active learning methodologies, such as small-group learning. Students can develop ideas, use language, learn from each other, and recognize that their opinions and experiences are valued and necessary for new learning when they work in groups (Bartley & Milner, 2011).

Related Studies

The following pertinent studies were reviewed to give the study more depth.

The impact of direct instruction in boosting non-native student achievement in English classes was investigated by Al-Shammari et al. (2008). In this study, one group was exposed to direct instruction, while the other did not get any direct instruction. Direct instruction is a realistic way to teach English as a foreign language, as seen by the results. In addition, the author addressed how direct education saves time in the classroom and how it is a viable alternative to traditional teaching methods.

Furthermore, the usefulness of Direct Instruction in reading comprehension programs for pupils was discussed in research by Flores and Ganz (2007). According to the study's findings, there was a significant and immediate improvement in student performance between the baseline and treatment groups. On the other hand, the author modified the DI strategy by adding visual signals to the mix.

Botts et al. (2014) compared activity-based intervention and embedded direct instruction. Preschoolers, particularly those in the phonological class, were the study subjects. In order to acquire phonological awareness abilities, it was more effective and efficient to use direct training incorporated in the classroom. The structure needed to facilitate effective and efficient skill acquisition, generalization, and learning retention was given by embedded direct instruction.

In a 1992 study, Bay et al. investigated the efficacy of two instructional modalities (direct instruction and exploration) on the student's science accomplishment. According to the study's results, an initial posttest, pupils in both groups learned at the same rate. Regarding the retention exam administered two weeks following the posttest, students who took the discovery strategy outperformed those who took the direct instruction approach. As a result, in the science curriculum, direct instruction may not be as effective as it may be.

On the other hand, this study will also cover some relevant research on using Constructivism Learning Theory to integrate active learning strategies in the learning and teaching process.

In a study by Nuez et al. (2021), active learning strategies and methodological tools such as collaborative work was used to assess the impact of the intervention on students' disciplinary knowledge. It was discovered that using active learning strategies in the field of physics has a positive impact on the student's disciplinary knowledge, as they can learn and reinforce it while having the opportunity to acquire new knowledge and understanding.

The effectiveness of an active learning experience for the conceptual learning of kinematics of students taking the subject of physics in an elementary and middle school was determined in a study by Hernandez et al. (2021), which showed that the intervention supported by active strategies, especially group work, favored participation in all phases of the project and allowed significant learning in the students under study.

The impact of active learning methodologies on the difference in male and female performance in introductory physics classes was also explored by Lorenzo, Crouch, and Mazur (2006). They discovered that including active engagement tactics helped all students, but it had the most considerable influence on the performance of female students. The gender gap was closed when they used a "heavy dose" of active learning methodologies. This finding backs up previous research that suggests active learning benefits women (Laws et al., 1999; Schneider, 2001).

On the other hand, student performance in undergraduate science, technology, engineering, and mathematics (STEM) courses under traditional lecturing versus active learning improved by about 6% in active learning sections. On the other hand, students in traditional lecturing classes were 1.5 times more likely to fail than students in active learning classes, according to a study by Freeman et al. (2014). The active learning method also appears to boost students' scores on concept inventory more than on course exams, and it works well in all class sizes, according to the research.

Haak et al. (2011) also investigated the effects of active learning on students in the University of Washington's Educational Opportunity Program (EOP). The latter were enrolled in an introductory biology course and discovered that all students benefited when active learning strategies were incorporated into the introductory biology course. However, students in the EOP benefited disproportionately, lowering the achievement gap to roughly a quarter of the starting level. These results provided another compelling reason to incorporate active learning approaches into the course design.

Furthermore, Ruiz-Primo et al. (2011) found that when comparing the effects of an innovation (i.e., active learning approaches) to traditional instruction that did not include the innovation, the effect size was more prominent. Overall, they discovered that using active learning methods improved student performance; however, there are several important considerations to keep in mind.

A study by LoPresto et al. (2016) showed that the majority of students believed that the activities that are active and collaborative helped them learn introductory astronomy solar system topics through a combination of collaborative learning activities and that the majority of students believed that the activities that are active and collaborative nature helped them learn. Students reported that they learned more by being given challenges, forced to think critically, and encouraged to participate in group activities. This demonstrates that students believe that doing things independently rather than having them explained to them and cooperating with others rather than working alone would help them learn. Teachers who implement active learning should consequently see increased student accomplishment and better student attitudes.

However, Karamustafaoglu (2009) discovered that while most teachers concur that active learning strategies are better for long-term learning and more effective, some teachers contend that active learning cannot be used to teach Physics because it is a numerical subject. Teachers still choose conventional teaching strategies like problem-solving, expression, and question-answering, believing that the more questions they solve, the more successful their students will be on the exam.

To illustrate further how the theories, concepts, and literature are integrated into the study, the theoretical–conceptual framework is provided in Figure 1.

Theoretical-Conceptual Framework of the Study

The theoretical-conceptual framework of the study is presented in Figure 1.

Figure 1 Theoretical-Conceptual Framework of the Study in Schematic Diagram

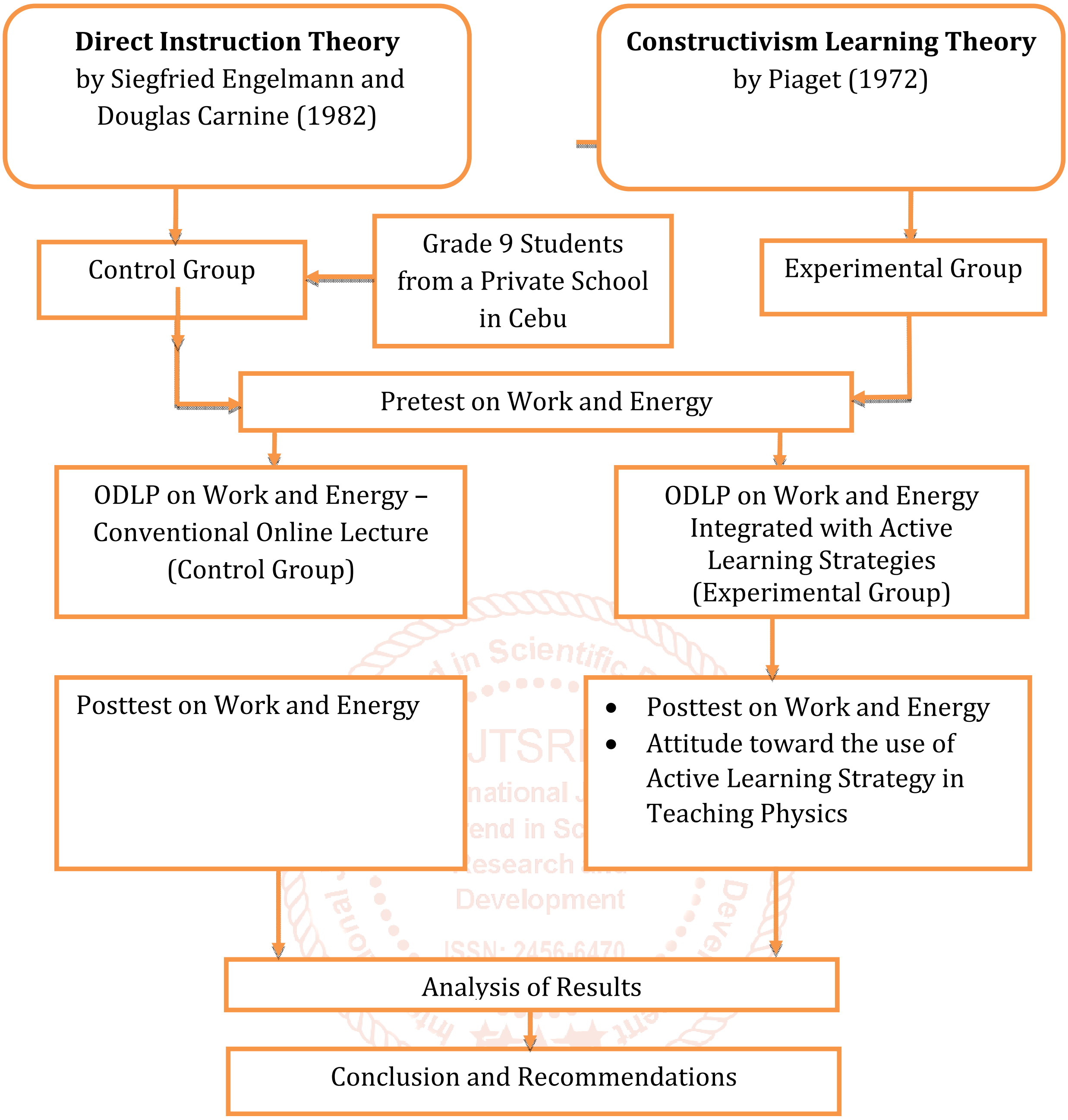

Figure 1 depicts the study's theoretical-conceptual framework. The approach was based on Piaget's Constructivism Learning Theory and Direct Instruction Theory by Siegfried Engelmann and Douglas Carnine.

To see if integrating active learning strategies in teaching Physics is beneficial or not in eliciting students' conceptual knowledge and problem-solving skills on notions of work and energy, two homogenous Grade 9 classes from a private school in Cebu City were divided into two groups. One group was exposed entirely to an ODLP having activities without integration of active learning strategies in the online teaching and learning process. At the same time, the other used the same ODLP but with the integration of active learning strategies in the activities within the online teaching and learning process.

The pretest and posttest that were administered were the same for each group. After then, test results were compared to see if there was a substantial difference between the two groups. Following the posttest, the experimental group answered a 4-point Likert Scale to assess their attitude towards using active learning strategies in teaching Physics work and energy. The findings were analyzed to come up with a sound and complete conclusion and specific recommendations.

Significance of the Study

The result of the study would benefit the following:

the **curriculum developers** could be provided with data on the effectiveness of using the active learning strategies in the teaching and learning process and could make them aware of the importance of active learning and its components in teaching Physics concepts such as work and energy;

the **Science teachers** could be guided in planning online activities in the lesson that could attend to the needs of the students, especially in learning the subject, thus, improving their student's understanding and facilitating the learning of advanced knowledge;

the **students** could be aided in overcoming their difficulties in understanding the concepts of work and energy by incorporating several active learning strategies into the lesson, and their comprehension of these ideas as one of the fundamental ideas that shape our universe will also help them cultivate a scientific mindset that will enable them to appreciate the beauty of the universe; and

the **future researchers** could be given information in such a way that they could use the results of the study when conducting other research with the same concepts of the effectiveness of active learning strategies in the teaching process. Also, this study could tell them the things needed to improve to enhance students' learning in Physics.

Scope and Delimitation of the Study

The study aimed to determine the effectiveness of active learning strategies in teaching Physics online classes. Additionally, the topics that were used in the study were the following: (1) Energy and (2) Work which are part of the lessons in the given subject of the students based on the Adaptive Curriculum of the school and following the Most Essential Learning Competencies (MELCS) provided by the Department of Education.

The researcher conducted the study in the Fourth Quarter of the Academic Year 2021-2022, from March to April 2021-2022. The study subjects were the Grade 9 students of a private high school in Cebu City. Two sections of students were involved in the study; one was for the control group, and the other one was for the experimental group. The control group was exposed to the conventional lecture method without integrating active learning strategies. On the other hand, the experimental group was exposed to the integration of active learning strategies. A 4-Likert Scale questionnaire was given to the experimental group to address students' attitudes toward using active learning strategies in teaching Physics. Both control and experimental groups were given a focus group discussion to gather ideas about students' experiences during the intervention process.

Definition of Terms

The following terms were defined according to their use in the study:

Active Learning Strategies. These teaching strategies integrated into teaching Physics engage students actively in learning, using activities such as reading, writing, discussion, or problem-solving, which promote analysis, synthesis, and evaluation of class content.

Online Distance Learning Plan (ODLP). This refers to the learning plans used in the study and is made up of a different set of activities that will be applied in the teaching and learning process.

ODLP on Work and Energy. A validated researcher-made online distance learning plan (ODLP) that has the following parts: (a) an identical standardized pretest and posttest are given through the Aralinks LMS online; (b) a syllabus that contains the overview and timeframe of the lesson; (c) activities on Work and Energy with conceptual and problem-solving exercises in the learning plan.

ODLP on Work and Energy with Active Learning Strategies. A validated researcher-made online distance learning plan (ODLP) that has the following parts: (a) an identical standardized pretest and posttest are given through the Aralinks LMS online; (b) a syllabus that contains the overview and timeframe of the lesson; (c) activities on Work and Energy integrated with active learning strategies with conceptual and problem-solving exercises in the learning plan.

2. RESEARCH METHODOLOGY

This chapter presents the study's research methodology, including the research design, research environment, research subjects, data gathering procedure, pedagogical approach, research instrument, research ethics consideration, data management plan, and statistical data treatment.

Research Design

The quasi-experimental method was used in this study, with a two-group pretest-posttest design. Furthermore, the active learning strategies were included in the learning plan, which was modified. Quantitative comparison was performed in the analysis to assess the significant difference between the control and experimental groups.

Below is the diagram of the research design:

G_1	O_1	-	O_2
G_2	O_3	X	O_4

Where:

G_1 = is the control group that utilized the ODLP without active learning strategies through conventional online lectures,

G_2= is the experimental group that utilized the ODLP with active learning strategies,

X = online distance learning approach using the learning plan with the integration of active learning strategies,

O1 = is the pretest of the control group,
O2 = is the posttest of the control group,
O_3 = is the pretest of the experimental group, and
O_4 = is the posttest of the experimental group.

Research Environment

This study took place in one of Cebu City's private schools. The Commission on Higher Education (CHED) has given the school an autonomous status. It is recognized by the Philippine Accrediting Association of Schools, Colleges, and Universities (PAASCU) as a learning institution with the most accredited programs after seventy-five years of quality education.

Due to the current pandemic, the school offers both synchronous and asynchronous homogeneous and heterogeneous classes. To achieve educational excellence and generate success-oriented students, it uses Understanding by Design (UBD) and Project-Based Learning (PBL) in its curriculum. There are five sections for the Grade 7-year level, 6 for the Grade 8-year level, 9 for the Grade 9-year level, and 11 for the Grade 10-year level. The total population of the Junior High School Department students is 1,162, and the total population of the faculty is 57 teaching staff.

Research Subjects

The research's subjects were 69 students from two homogeneous Grade 9 classes in the Academic Year 2021–2022. Before the experimental procedure, each homogeneous class was assigned to one of the two groups: control or experimental. Through a verified researcher-made online distance learning plan, the control group was exposed to the ODLP in teaching Physics without integrating the active learning strategies in the lesson. On the other hand, the experimental group was exposed to teaching Physics concepts of work and energy while incorporating active learning strategies.

Data Gathering Procedure

The following stages were included in this study: (a) research approval, (b) pretest administration, (c) experimentation, (d) posttest administration, (e) a 4-point Likert Scale attitude survey questionnaire about the use of Active Learning Strategies in Physics teaching (experimental group only), and (f) focus group discussion both control and experimental groups.

The Office of the Vice-President of Academic Affairs and the school principal of the chosen private school in Cebu City received a transmittal letter (See Appendix A). The school's research committee may hold a research proposal hearing to determine whether the researcher's work meets the school's requirements. Following approval, consent forms for research participation were distributed to the students and parents asking for permission to use the students as research participants, with the assurance that the study strictly adhered to the Data Privacy Act and Child Protection Policy (See Appendix B).

This study was conducted during the Fourth Quarter of the Academic Year, from March to April 2021-2022. The researcher gave both control and experimental groups a validated pretest. Two sets of questionnaires for the selected physics concepts of work and energy would cover the Department of Education's Most Essential Learning Competencies. The two groups were comparable, as shown by their pretest results.

The experiment was carried out in synchronous classes, with the control group exposed to the ODLP without the active learning strategies integration and the experimental group exposed to the ODLP with the active learning strategies integration. Following that, a posttest was then given.

After completing the pretest-posttest of the prescribed topics, the experimental group answered a 4-point Likert Scale attitude survey about using active learning strategies in teaching Physics. The attitude survey questionnaire was answered via Google Forms, and focus group discussions were conducted with control and experimental groups to enrich and validate the outcomes. The data were used to solve the study's problems.

Pedagogical Approach

Two pedagogies were used in this study to teach the fundamental principles of selected topics in Grade 9 Physics, namely work, and energy. The control group was taught with the ODLP and no active learning strategies, while the experimental group was taught with the OLDP and active learning strategies.

Control Group

The control group subjects answered a pretest using a validated questionnaire created by the researcher before beginning the experimentation procedure. On the selected topics in Physics, notably, work and energy, the group was taught using the ODLP without including active learning strategies in conventional direct instruction online (See Appendices I and J for ODLP). During synchronous classes, the teacher discussed the topic utilizing an online platform and a PPT presentation without integrating any active learning strategies. After all the lessons discussed, the student answered the post-test using a researcher-made validated questionnaire.

Experimental Group

Subjects in the experimental group, like those in the control group, answered a pretest before undergoing the experimental intervention. On the same topics, the group was exposed to online lectures via an online platform utilizing the ODLP, as well as active learning strategies such as inquiry learning, think-pair-share, active review session, grab a volunteer peer review, and active self-assessments (See Appendices K and L for ODLP). The teacher was responsible for conducting the online lecture using the experimental intervention and making the most of the upgraded online lecture material. The students answered a post-test after the topics had been covered. The group was asked to complete a 4-point Likert Scale attitude survey, and a Google forms survey about using active learning strategies in teaching Physics. Finally, all control and experimental group students were asked to participate in a focus group discussion using the video conferencing app, where they answered a series of questions and shared their perspectives on the intervention.

Research Instruments

The instruments used in this study were the following: (a) the researcher-made pretest and posttest questionnaire - a 20-item multiple choice test that measured students' conceptual understanding and problem-solving in Physics which covered the topics work and energy (See Appendix D and E). There were two sets of pretest and posttest questionnaires-one for the topic work and the other for the topic energy. The researcher made a 4-point Likert Scale attitude survey questionnaire for the experimental group used only to identify the level of attitude of the students on the use of active learning strategies in teaching physics - work and energy concepts (See Appendix G). Finally, a researcher-made questionnaire for the focus group discussion in both the control and experimental group (See Appendix H).

The researcher consulted experts in Physics teaching to determine the validity of all study instruments that will be utilized in teaching Physics concept work and energy for both the control and experimental groups. Validators rated the pretest-posttest (See Appendix F), the two ODLP, the 4-point Likert Scale attitude survey questionnaire, and the focus group discussion questionnaire using the content validity test and readability test concerning the learning competencies. These are adopted from the Most Essential Learning Competencies of Grade 9 Physics course syllabus to check common errors like double-barreled, confusing, and leading questions before administering them to the assigned group in the study. Suggestions from the validators were implemented to improve all the said research instruments. Furthermore, the pretest-posttest questionnaire has been pilot-tested and undergone a reliability test using the split-half type analysis using the Spearman-Brown formula.

Research Ethics Consideration

A letter was sent to the selected institution's vice president for academics to see whether they would allow the study to be conducted with students. The vice president approved the identification of potential students for academics.

The tested students were informed about the study and requested to sign an informed consent form (See Appendix B) if they agreed to participate. The students' scores were maintained with strict confidentiality, and their identities were obscured when the data were processed and interpreted.

Data Management Plan

The collected data could be held in public access for five years to be used for research revisions, publishing, or as a reference in case of questions or inquiries about the study. The researcher produced an electronic copy of the data and saved it on the hard drive to ensure its longevity. All data collected were anonymized to protect the respondents' confidentiality. To ensure data confidentiality, the remaining questionnaires and answers, as well as the electronic documents, were erased after processing and interpreting the data following the Data Privacy Act of 2012.

Statistical Treatment of Data

The study employed the following statistical techniques:

1. One sample z-test was used to determine the pretest and post-test performance of the students in both the control group and experimental group, as shown below:

Formula $$z = \frac{|AM - HM|}{SD/\sqrt{n}}$$

Where:
z = computed t-test value,
AM = actual mean,
HM = hypothetical mean (60 % of the total score),
SD = standard deviation, and
n = sample size.

2. A paired sample t-test was used to determine the significance (mean gain) of the students' performance from the pretest to the posttest of both the control and experimental groups as shown below:

Formula $$t = \left| \frac{\bar{d}}{S_d / \sqrt{n-1}} \right|$$

Where:
t = computed t-test,
$\bar{d}$ = mean of differences,
Sd = standard deviation of the difference, and
n = sample size.

3. The t-test of independent samples was utilized to determine the significant the difference in the mean gains between the control and experimental groups is shown below:

Formula $$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{SD_1^2}{n_1} + \frac{SD_2^2}{n_2}}}$$

Where:
t = computed t-test value,
$\bar{x}_1$ = mean gain of the experimental group,
$\bar{x}_2$ = mean gain of the control group,
SD_1 = standard deviation of the difference of the experimental group,
SD_2 = standard deviation of the difference of the control group,
n_1 = sample size of the experimental group, and
n_2 = sample size of the control group.

4. The weighted mean will be utilized to determine the attitude of Grade 9 students toward the use of active learning strategies in teaching physics, specifically concepts of work and energy as shown below:

Formula $$WM = \frac{\sum x W}{\sum W}$$

Where:
WM = weighted mean,
x = each of the item value,
W = weight of each item, and
"Σ" = the sum of.

All tests were done at 5% lev[illegible]ce.

3. PRESENTATION, ANALYSIS, AND INTERPRETATION OF DATA

This chapter presents the results, analysis, and interpretation of data on the performance of the Grade 9 students in teaching Physics who were exposed to different learning plans.

Performance Level of the Grade 9 Students in Physics

Table 1 reveals the pretest performance level of Grade 9 students in Physics.

Table 1 Pretest Performance Level of the Grade 9 Students in Physics

Group	n	HM	AM	SD	Test Statistic		Qualitative Description
					Computed z-value	p-value	
Control (Without Active Learning Strategies)	34	14.40	17.68	2.61	7.33	< .00001*	Above Average
Experimental (With Active Learning Strategies)	35	14.40	17.71	2.40	8.16	< .00001*	Above Average

Note. HM = 60% of the total number of items; based on the passing standard of the school where the research was conducted
*significant at α = 0.05 (two-tailed test)

Table 1 shows that the actual mean (AM) of the control group is 17.68 (SD=2.61), and the actual mean of the experimental group is 17.71 (SD= 2.40). The scores of both groups in the pretest were higher than the hypothetical mean (HM), z= 7.33 and 8.16, respectively, $p < .00001$. These values were significant; thus, H_{O1} was rejected. This means that there were significant differences between the hypothetical mean and the actual mean of the experimental and control groups. Their performance in the pretest was **Above Average**. Both groups were way above the hypothetical mean (HM) of 60%, the passing standard criterion set by the school where the study was conducted. This above-average performance of both groups could be attributed to the assumption that the topics were familiar to them already since they had acquired ideas about these given concepts during their lower years since the teachers were following the Department of Education spiral curriculum of teaching in Science subject.

Table 2 presents the post-test performance level of Grade 9 students in Physics.

Table 2 Posttest Performance Level of the Grade 9 Students in Physics

Group	n	HM	AM	SD	Test Statistic		Qualitative Description
					Computed *z*-value	*p* –value	
Control (Without Active Learning Strategies)	34	14.40	19.74	2.48	12.56	< .00001*	Above Average
Experimental (With Active Learning Strategies)	35	14.40	20.34	1.59	22.10	< .00001*	Above Average

Note. HM = 60% of the total number of items; based on the passing standard of the school where the research was conducted

*significant at α = 0.05 (two-tailed test)

Table 2 reveals that during the posttest, the control group had an actual mean (AM) of 19.74 (SD= 2.48), while the experimental group had an actual mean of 20.34 (SD= 1.59). The posttest performance of both groups yielded significant results, as shown by their z values of 12.56 and 22.10 for the control and experimental groups, $p < .00001$. H_{O1} was rejected, meaning there were significant differences between the hypothetical and actual means of the control and experimental groups. The performance of the students in the post-test was **Above Average**. This suggests that the control and experimental groups obtained an actual mean higher than the hypothetical mean (HM) of 60%, which is the passing standard criterion set by the school where the study was conducted. This may imply that students probably have acquired more understanding of the concepts related to energy and work with or without using the different active learning strategies integrated with the learning plans within three weeks of learning through online distance learning.

The findings of this study supported the study of Mascolo and Fisher (2005), who believed that knowledge is an intersubjective interpretation that is best acquired through a process of interaction of experiences and ideas. This means that the learners must take into account the material being taught and create an interpretation based on their prior knowledge. Students acquired understanding since some topics were already introduced during their lower years, supported by the findings of this present study.

Mean Improvement of the Grade 9 Students in Physics from the Pretest to the Posttest

Table 3 shows the mean improvements of the control and experimental groups in their performance in Physics.

Table 3 Mean Improvements of the Control and Experimental Group in Physics

Group	n	Pretest Mean	Posttest Mean	$\bar{d}$	S_d	Test Statistic	
						Computed t-value	*p*-value
Control (Without Active Learning Strategies)	34	17.68	19.74	2.06	3.16	3.801*	.00059*
Experimental (With Active Learning Strategies)	35	17.71	20.34	2.63	2.79	5.577*	< .00001*

*significant at α = 0.05 (two-tailed test).

As indicated in Table 3, the control group, which was exposed to an online learning plan without integrating active learning strategies, had a mean gain of 2.06 (S_d = 3.16). This showed a significant mean improvement in the posttest (M= 19.74) from the pretest (M=17.68), t (33) = 3.801, p = .00059. For the experimental group, which was exposed to active learning strategies, a mean gain of 2. 63 (S_d = 2.79) was obtained. Significant improvement was shown in the posttest (M=20.34) from the pretest (M=17.71), t (34) = 5.577, p = <.00001. In both cases, H_{O2} was rejected. This means that the students performed well in the posttest with or without the integration of active learning strategies. This would mean that both interventions effectively enhanced students' physics performance.

This may imply that students who were exposed to lessons without integration of active learning strategies still acquired an understanding of the concepts of energy and work in Physics because, during the teaching and learning process, the teacher was the primary source of knowledge and the one in charge in discussing the entire lesson while the students were just merely the recipient of knowledge. Furthermore, the teacher's way of delivering the lesson utilized the idea of the direct instruction method wherein thorough discussions were made by presenting the different learning objectives, asking the students questions from time to time to check their understanding and comprehension, and giving different examples of real-life application of the concepts discussed in the lesson. Even though the students were not so involved in the different activities to acquire knowledge in the learning process, they were still able to grasp and understand the lesson because of the presence of the teacher, who discussed the lesson well. These were supported by the following statements from the subjects in the focus group discussion:

> *"Such method is standard for how lessons are conveyed. Since it is the teacher centered, it is much comfortable and somewhat a navigated area."* - Student 23

> *"The activities integrated in the lesson was useful because it helped me understood the lesson and improves my understanding about the lesson."* - Student 25

> *"The way the teacher delivered the lessons in the process helped me learn different laws and applications that can be used in our daily life."* - Student 31

> *"The activities helped me gain and acquire deep knowledge. The way the teacher explained made the lesson easier to understand."* - Student 34

This study's findings supported the study by Siegfried Engelmann and Douglas Carnine. (1982),which believed that the teacher is always the source of knowledge within the four walls of the classroom. Through practical lessons, corrective feedback, and practice opportunities, this instructional technique, also known as explicit teaching, requires the teacher to keep the students engaged in class. Other studies that corroborated the findings of this study were Magliaro et al. (2005), who emphasized that this form of instruction is suitable because it has a clear framework and the capacity to provide learners with opportunities for practice and immediate feedback. Botts et al. (2014) pointed out that giving direct instruction in the teaching and learning process is more effective and efficient since it promotes direct training incorporated in the classroom.

On the other hand, the improvement in the experimental group's performance may imply that the different active learning strategies made the lesson more manageable and convenient and increased the active involvement of the students in the teaching and learning process. Moreover, the activities with active learning strategies in the learning plan could have promoted students' engagement by catering to all their different learning styles and intelligence. Furthermore, this indicates that integrating active learning strategies could improve students' performance since it encourages students to participate in discussions actively and boosts learning within the classroom/meeting (online arrangement), and undoubtedly aids students learning and comprehension of the topics, which helped them to grasp concepts quickly and could apply them in real-life situations. These were supported by the following statements from the subjects in the focus group discussion:

> *"To be honest, I truly liked the active learning strategy because it helped me become more involved in the discussion and it made everything a bit more productive."* - Student 1

> *"Active learning activities did not only enhance my knowledge but also honed my communication skills which enabled me to share ideas and collaborate more effectively."*- Student 21

> *"This active learning helped me understand the lessons better and interact with my classmates by sharing our thoughts and what we knew about the topic."* - Student 33

> *"On my end, the active learning activities were useful for me to understand the topics in Physics well, since after we do the activities, the teacher would explain the lesson further and give more examples. Furthermore, such activities also enabled me to understand the concepts easily."* - Student 37

The findings of this study supported the following studies: Nuez et al. (2003) pointed out that the use of active learning strategies in teaching Physics has a positive impact on students' disciplinary knowledge as they are to learn and reinforce it while having the opportunity. Additionally, active learning strategies can make students shift from passive recipients of knowledge to active participants in activities that involve analysis, synthesis, and scientific assessment while also developing skills, values, and attitudes (Livingstone & Lynch, 2003). Furthermore, Kalem & Fer (2003) pointed out that utilizing active learning approaches have beneficial effects on learning, teaching, and communication, while Sivan et al. (1991) pointed out also that the active learning approaches developed and improved the overall growth of students' communication and problem-solving skills, as well as their critical thinking abilities.

However, this study negated Karamustafaoglu (2009), who explained that although most teachers believe that active learning approaches are beneficial for long-term learning and are more effective, some teachers argue that active learning cannot be implemented in teaching Physics because it is a numerical subject.

Comparison of the Mean Improvements in Physics of the Control and Experimental Groups

The mean improvement in Physics of the experimental and control groups is shown in Table 4.

Table 4 Comparison of the Control and Experimental Group in Terms of Their Mean Improvement in Physics

Group	n	*Mean Gains* $\bar{d}$	S_d	Difference Between Means	Test Statistic	
					Computed t-value	p-value
Control (Without Active Learning Strategies)	34	2.06	3.16	0.79	1.996	0.432 ns
Experimental (With Active Learning Strategies)	35	2.63	2.79			

Note. **not significant at α = 0.05.

As shown in Table 4, a mean difference of 0.79 was obtained in favor of the experimental group. However, the result was insignificant, t (67) = 1.996, p = 0.432. This failed to reject $H_{O3,\ meaning}$ no significant difference in mean gain in Physics performance existed between the control and experimental groups. Both groups had comparable performance in the subject quantitatively and qualitatively, as mentioned in the previous tables. Looking closely into the interventions, for the control group, who were just passive receivers of knowledge, much of the student's learning could be attributed to the teacher, who was the direct source of the knowledge and information through explicit teaching. These were supported by the following statements from the subjects in the focus group discussion:

> *"The activities in the lesson were adequate. Enough to keep me engaged and not too much that it overwhelms me. The activities provided a background for me to understand the given topic with the supervision of the teacher in the process."* - Student 19

> *"Some of activities are quite challenging yet they can be understood and can be learned in some ways with the helped of the teacher. The most helpful feature is that there is a mentor along this unique learning experience."* - Student 23

> *"It helped me understand the lesson with the guidance of the teacher during discussion."*- Student 30

The findings of this study were in agreement with the study by Adams and Carnine, (2003), which said that the teacher is in charge of the student'seducation; he or she must always keep the students' attention focused in order for them to acquire new knowledge and understand the given idea presented fully. The structure needed to facilitate effective and efficient skill acquisition, generalization, and learning retention was given by embedded direct instruction, according to the study of Botts et al. (2014). The Direct Instruction Theory by Siegfried Engelmann and Douglas Carnine states that when it comes to direct education, this is a common occurrence: the teacher is the source of knowledge and asks different process questions to the students. The study's findings affirmed that learners are just passive recipients of information and are not usually actively involved in the process.

On the contrary, despite less teacher presence in the experimental group who acted only as a facilitator, learning the concepts was primarily due to the student's active involvement using the different active learning strategies. Still, their performance was more or less similar to that of the control group. This may imply that with the integration of the active learning strategies in the lesson, students were still able to grasp understanding and to learn similarly with the control group (teacher-dominated) the given concepts, such as energy and work, with less teacher supervision. These were supported by the following statements of the subjects in the focus group discussion:

> *"I really enjoyed the experience throughout the lessons. I find them very effective and efficient in learning these topics especially in the new way of learning."* - Student 7

> *"The active learning activities were effective for me because it did help in guiding me for things to be understood in an easier way."*- Student 8

> *"I can say that the active learning activities really helped me a lot to be motivated especially that tasks like this doesn't need a lot of time to make. Hence, it pushed me to be on time and avoid procrastinating. Moreover, student like me can also learn and understand the lessons easier through this method."* - Student 20

> *"These active learning strategies helped me understand the lessons better and interact with my classmates by sharing our thoughts and what we knew about the topic."* - Student 36

The findings of this study supported the study of Bartley and Milner (2011), which pointed out that students can develop ideas, use language, learn from each other, and recognize that their opinions and experiences are valued and necessary for new learning. Additionally, active strategies, especially group work, favored participation in all phases of the project and allowed significant learning in the students under study (Hernandez et al.,2021), while DeWitt (2003) pointed out that the active learning method that is employed in the classroom, demonstrating that it can engage students and change their attitudes about science and learning. The Constructivism Learning Theory by Jean Piaget states that humans produce knowledge by interacting with their experiences and ideas, and the individual is at the heart of the knowledge generation and acquisition process was confirmed by the findings of this study.

Levels of Attitude of the Experimental Group Towards the Use of the Active Learning Strategies in Physics

Figure 2 presents the level of attitude of the experimental group toward the use of active learning strategies in Physics

Figure 2 The Level of Attitude of the Experimental Group toward the Use of the Active Learning Strategies in Physics

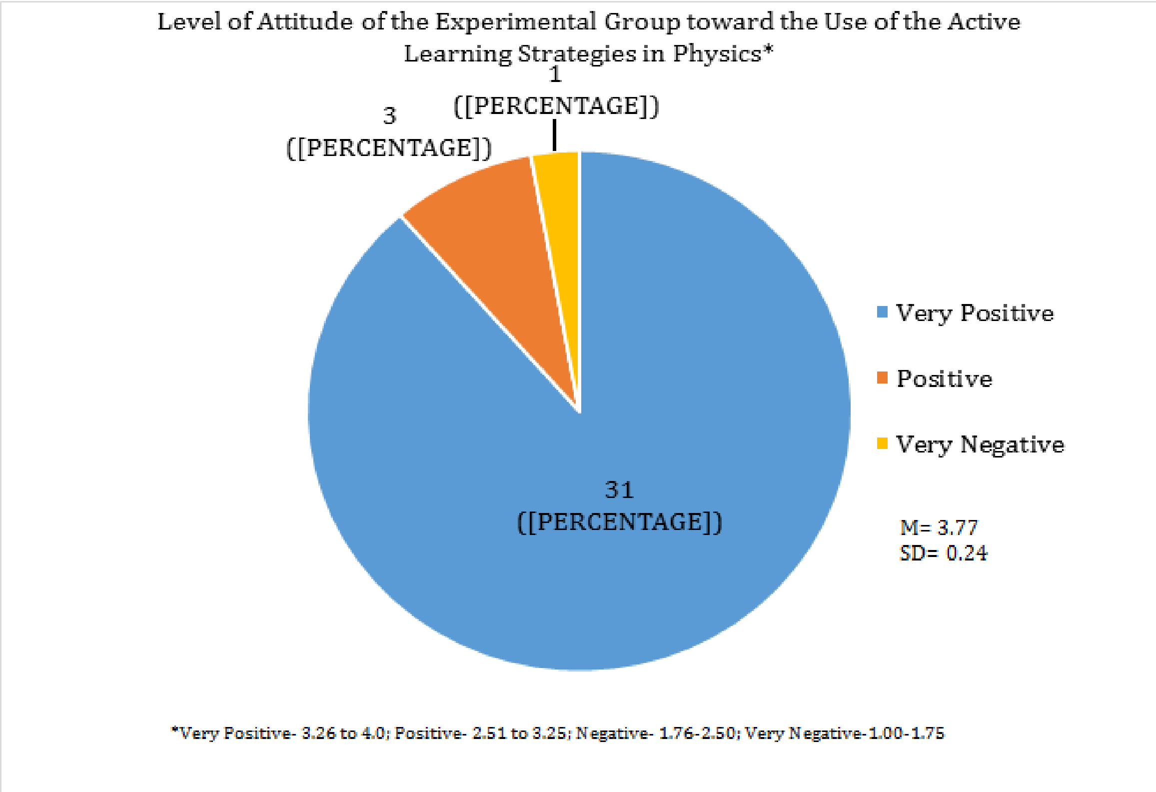

Figure 2 reveals that most of the students, 31 (88.6%) in the experimental group, exhibited a **Very Positive** attitude towards using active learning strategies in Physics. These students had a mean of 3.77 (*SD* = 0.24), categorized as **Very Positive**. This may imply that integrating the different active learning strategies in the lesson was helpful for them to understand the topics in Physics since probably students find it convenient because of how their productivity increased compared to before.

This implies that the active learning techniques used in the course enabled the students to identify new avenues to learn that may improve attitude and value comfortably. The various simulations, interactive activities, and presentations used in the learning process might have improved students' performance in learning the given topics. This positive attitude encourages the students to participate in discussions actively and grasp concepts smoothly to apply them in real-life settings. Integrating active learning strategies help students enjoy and improve their attitude toward school and learning. Furthermore, such strategies also allow scientific attitude improvement, cultivate fundamental scientific thinking fundamentals, and generate creativity in solving problems.

The findings of this study validated the study of Suwondo dan Wulandari (2013), who elucidated that the addition of active learning methods of teaching can improve students' attitudes toward school and learning in general because they allow them to improve their scientific attitudes cultivate the fundamentals of scientific thinking in students, and generate their creativity in solving problems.

Furthermore, Price (2004) pointed out that students' attitudes and understanding increase due to active learning application in the learning and teaching process because the goal is to create a balance between lecturing and active learning approaches was also affirmed by the results of this study.

4. SUMMARY, CONCLUSION, AND RECOMMENDATIONS

This chapter presents the study's summary, findings, conclusions, and recommendations.

Summary

This study employed the quasi-experimental method with a pretest-posttest control group design that aimed to determine the effects of using active learning strategies in teaching Physics using the researcher-made online distance learning plan. Specifically, this study sought to answer the following questions:

1. What is the pretest-posttest performance in Physics of the Grade 9 students in the:
   1.1. Control group (exposed to Online Distance Learning Plan without active learning strategies) and;
   1.2. The experimental group (exposed to Online Distance Learning Plan with active learning strategies)?
2. Is there significant mean improvement in Physics performance from the pretest to the post-test of the Grade 9 students in the:
   2.1. Control group (exposed to Online Distance Learning Plan without active learning strategies) and;
   2.2. The experimental group (exposed to Online Distance Learning Plan with active learning strategies)?
3. Is there a significant difference in the mean improvement in Physics performance between the control group and the experimental group?
4. What is the level of attitude of the experimental group toward the use of active learning strategies in teaching Physics?

Findings of the Study

After the analyses of the data, this study obtained the following results:

1. Both control and experimental groups manifested **Above Average** performance in the pretest and the posttest.
2. There were **significant mean improvements** in the student's performance in Physics from the pretest to the posttest in both experimental and control groups.
3. There was **no significant difference** in the mean improvement in Physics between the experimental and control groups.
4. The experimental group exhibited a **Very Positive** attitude toward using active learning strategies in Physics.

Conclusion

Online distance learning can be done in various ways using different online platforms. It utilizes different teaching methods and strategies to help students actively participate and engage them in the teaching and learning process, such as integrating different active learning strategies.

Based on the findings of the study, the integration of active learning strategies to the group with less teacher presence (acts only as facilitator) proved to be as effective as the group who received explicit teaching from the teacher in teaching Physics. In addition, it did not only enhance the student's performance as manifested by their comparable performance with the other group but was also influential in developing a positive attitude that affected the student's performance. Then it would allow us to conclude that exposing the student to various activities using active learning strategies, even when there is less teacher supervision, would undoubtedly help them improve their performance in class and increase the possibility of acquiring a positive attitude towards the subject they are learning. With this optimistic attitude, students strive to exceed what is required by established criteria in the subject they are learning.

The theories of Direct Instruction by Siegfried Engelmann and Douglas Carnine believe that teacher-centered teaching strategies are effective in teaching Physics since the teacher does the explicit teaching directly to the students with less active participation and involvement in the process, discussing the concepts thoroughly with the use of different process questions to help the students in acquiring an understanding of the lessons. Constructivism Learning Theory by Jean Piaget states that involving the students actively and exposing them to a set of activities that will engage them in the teaching and learning process can help them enhance their performance and attitude since they acquire learning by interacting with their actual experiences in the process, were both confirmed by the findings of this study.

Recommendation

In light of the findings, the following recommendations are suggested:

1. curriculum developers include different active learning tasks that would enable students to involve and engage in the lesson;
2. science teachers include active learning strategies in the teaching of Physics;

3. students should be given different learning strategies in the teaching and learning process to overcome the difficulty in Physics; and
4. future researchers will conduct a similar study on a face-to-face mode of instruction.

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