Journal Homepage: -www.journalijar.com

INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)

Article DOI:10.21474/IJAR01/17041
DOI URL: http://dx.doi.org/10.21474/IJAR01/17041

RESEARCH ARTICLE

EFFECT OF UTILIZING INTERACTIVE VIRTUAL LAB ON STUDENTS' PERFORMANCE IN PHYSICS

Clint Erven H. Mosqueda

……………………………………………………………………………………………………....

Manuscript Info

……………………..

Manuscript History
Received: 25 March 2023
Final Accepted: 30 April 2023
Published: May 2023

Abstract

………………………………………………………………

CLINT ERVEN H. MOSQUEDA. 2023. Effect of Utilizing Interactive Virtual Lab on Students' Performance in Physics, MSTP Thesis. Graduate School, University of Southern Mindanao, Kabacan, Cotabato. 80pp.Major Adviser: JEAN R. MAGANAKA, MSTPThis research investigated the effect of utilizing interactive virtual lab (Labster) on students' performance in physics among the grade 10 of Dungoan High School. It is a quasi-experimental research that uses the Randomized Pretest-Posttest Control Group Design, Using Matched Subjects. Differences in the performances of students who used Labster (experimental group) and with those who did not utilize it (control group) were tested in terms of the result in the posttest. Students' performances were measured using a 40-item test that undergone pilot testing and content validation.Results revealed that the significant increase of students' performance in the experimental group provides positive effect as (computed U = 2.000, $p < 0.001$). It wasfound that the use of Labster contribute on enhancing students' learning in physics.Results in the rank gain scores with a significant difference in two groups (computed U = 5.500, $p < 0.001$) revealed that Labster also developed positive attitude towards learning physics with large Cliff's effect size difference of d = 0.71. Thus, there was a significant difference between the experimental and control group. The qualitative part of this research revealed that students' perception in utilization of Labster was a great technological integration in terms of learning contents, interface design, and learning experiences with a weighted mean of 4.08, 4.34, and 4.72 respectively. Moreover, the experimental group experienced difficulties while using Labster such as (1) program incompatibility with lower processor; (2) incapability to perform tasks with more than two activities at a time; and (3) insufficient computer literacy.

……………………………………………………………………………………………………....

Introduction:-

Background of the Study

Virtual Science Laboratory or Virtual Lab is an online/offline computer laboratory interface solution that may be used to complement, replace, or make-up laboratory to bridge the gap between lab and lecture. These laboratory simulations teach students the practical and intellectual skills they'll need to succeed in the laboratory. Labster is a computer application, described as an innovative interactive virtual laboratory of scientific simulations created by

Corresponding Author:- Clint Erven H. Mosqueda

integrated learning by using laboratory simulations that generate real-world situations through 3D immersive virtual user-selectable laboratories. With the help of this innovation, learners can demonstrate the laboratory experiment virtually by interacting to the computer application through giving commands and following instruction. Physics class requires laboratory activity since it has numerous advantages to accomplish learning objectives as suggested by the science curriculum (Medialdea&Sunagawa, 2020). The utilization of experiments in science laboratory makes it unique when compared to other subjects.

Unfortunately, Dungoan, one of the barangays in the municipality of M'lang is restricted to construct its school building and to provide laboratory facilities and equipment for their learners. Dungoan High School is one of the newly established high school with no formal classroom building and with no science laboratory facilities and equipment. The students in Dungoan High School stay in a temporary learning shelter (TLS) while waiting for the approval and construction of new classroom building. As reported by Pareek (2019), newly established schools in India lack laboratory facilities which led to the science teacher not to conduct lab activity. In the Philippines, some schools in San Pablo, Laguna were not able to perform laboratory experiments and activities due to the inadequacy of laboratory materials, apparatus and rooms, cited by de Borja and Marasigan (2020). In addition, students get frustrated and struggle a lot in the understanding of their lesson and complying the task given to them (Chen, 2022). The researcher found out that most physics lesson in science subject requires laboratory and experimental activities. Thus, teachers fail to adopt the lesson found in the learner's materials and other learning resources provided by the DepEd. Furthermore, alternative learning materials are limited due to a less school fund and demographic location. Dungoan High School's learning performance in science has been poor for the last two school years, which is reflected in the grade point average (GPA). This data was recorded in the school's database and reported by the School Monitoring, Evaluation & Plan Adjustment (SMEPA) coordinator to the division office for quarterly report as required.

In this paper, the researcher aims to find out whether technology can help fill this gap by implementing Labster as interactive virtual lab by modifying and contextualizing some lab activities. This allows students to investigate, observe, experience and simulate the use of a real laboratory equipment without putting students in danger by using computer application into laboratory activities as a teaching tool to increase conceptual understanding. Moreover, it enhances the students' performance using android application or computer program. This research was carried out by introducing an interactive virtual lab in learning physics and examining the respondents' pre and post test scores to see if there is a significant difference in their academic achievement before and after the strategy. The survey questionnaire was also included in the study to evaluate the perception of students while using Labster in terms of learning contents, interface design and operating experiences in learning physics. To enhance the teaching strategy and the methods in the field of science, specifically in physics, interactive virtual lab should be utilized in our lesson (Savvides et al., 2020).

This study provides a good support to the science curriculum formulated by the Department of Science and Technology to the Educational Framework presented to the Philippine Basic Educational Standards to provide a life-long learning to our learners, equipping them with scientific skills and attitude and to the Department of Education in providing a quality in education in all aspects.

Objectives of the Study:-

This study generally aims to determine the effectiveness of Labster on the learning performance of grade 10 students who currently enrolled to the school with no physical laboratory facilities and equipment.

Specifically, this study aims to:

1. determine whether there is a significant difference between the level of performance of experimental and control group before the strategy;
2. determine whether there is a significant difference between the level of performance of experimental and control group after the strategy;
3. determine whether there is a significant difference within the pretest and posttest scores of the experimental group;
4. determine whether there is a significant difference within the pretest and posttest scores of the control group;
5. determine if there is a significant difference between the gain score of the experimental and control group;
6. determine the perception of the students while using the Labster as interactive virtual lab in class laboratory

experiment in terms of learning contents, interface design and operating experiences; and
7. identify the difficulties students encounter while using the interactive virtual lab in class laboratory experiment.

Significance of the Study:-

The findings of the study benefit the following recipients:

For the learners, this study would help to motivate students to learn by meeting their desire for discovery through experimentation. In comparison to typical laboratories, interactive virtual laboratory requires multiple attempts and mistakes. As a result, using interactive virtual labs allow students to try several times without fear of failing. This online innovation of science provides opportunity to the learners to explore, discover and rediscover by the means of interactive simulation technology.

For the physics teachers, this help solves some of their problems. First, the absence of laboratory equipment and materials when performing experiments and tests. Then, it minimized their responsibility to students during the virtual laboratory. Lastly, ensure students' safety because interactive virtual laboratories are created with the current trend of technology. This would prevent the students from encountering dangers while demonstrating the lab experiment. Moreover, it also avoids physical danger as well as provides a reliable method of avoiding laboratory mishaps.

For the researchers, the research findings can used to improve academic analysis and future studies on the proper utilization of technological innovations in teaching and learning processes. This study would help to enhance education in the country through integrating virtual laboratories in teaching physics on the academic performance of the students.

Scope and Delimitations of the Study

This study was conducted in Dungoan High School. The target respondents of this research study were the Grade 10 students who were currently enrolled in the S.Y. 2022-2023. This study was focused on the physics lesson that covers a whole grading period. Moreover, in this research, forty (40) respondents were selected and evaluated based on their performance. Labster computer software/website was utilized in the strategy. The researcher in this study was the implementor and the educator in teaching physics lesson with the utilization of Labster as interactive virtual lab.

Operational Definition of Terms

The following terms were defined in order to have a better understanding of this study.

Control group is a group of students randomly selected who are taught using the conventional learning.

Conventional learning is an approach that refers to the way of teaching adopted and commonly used by the teacher wherein most of the time, lecture method is used. In this study, this refers to the used of activity in the explore/learning task without using laboratory activity due to the absence of laboratory facilities, tools and equipment.

Experimental group is a group of students who are taught with the utilization of the interactive virtual laboratory (Labster).

Explore is the part of the 7E's lesson plan format of DepEd for Math and Science teacher which students are given a task to perform individually or by group. In physics class for grade 10, students will perform activities allowing students to observe, infer, simulate and conduct laboratory activity.

Interface design is the architecture design shown on the screen while using the Labster.

Intervention is a new strategy designed to produce behavior change or improve learning achievement among students who are learning in physics.

Gain score is the difference between the posttest and pretest scores of the students.

Labsteris an example of Virtual Science Laboratory. An interactive virtual learning format. Itis a learning strategy where the intervention is based. It comprised of videos and images of the procedures and techniques performed.

Learning content is the topic expected to be learned and found in the science curriculum guide for Grade 10 Science, and this topic is also available in the Labster.

Operational experiences are the experiences of the respondents while using the virtual lab.

Pre-test is an initial assessment designed to measure existing knowledge. In this study, this will measure the prior understanding of students in learning physics lesson.

Post-test is an evaluation of any changes that have occurred after the intervention has been implemented.

Review Of Related Studies And Literature:-

This chapter deals with the review of the related literature and theories that is related to the overall framework of the present study. This helps in gathering some knowledge about the research problem, and provides a theoretical background to the study.

Nature and Models of Using Virtual Lab Experiments

This study is fastened in Pragmatism Theory by Dewey (1938). Pragmatism, also recognized as Experimentalism, promotes the experimental method of science, accentuating the practical importance of cognition. The concept that intelligent activity is always a type of testing of preliminary findings and hypotheses is known as experimentalism. Learners are said to be more interested and involved during in laboratory experiments. In today’s society, problem solving and an open class are more encouraged. The pragmatic method includes democratic classroom management, curriculum emphasis, and student-involved activities. Studies investigated the types of virtual experiments readily available online and the extent on how they can substitute for actual lab experiments: as studied by Li et al. (2011) the cognitive level of our learners can be enhanced with the use of virtual experiments by allowing our learners formulate hypotheses in problem solving situations. Numerous concepts and methods of virtual lab utilization in the current education in teaching science have been suggested by recent studies. One of the blended learning models (Aljanazrah, 2006) in which interactive virtual experiment were both real or hands-on experiments were present, and occasionally with non-physical experiments followed by physical experiments and could be done interchangeable (Verlage et al., 2019). Students can conduct experiments in a virtual lab setting, either on their own or in collaboration with other real-world labs (Roblyer& Hughes, 2014). Animation and the different functional tools of simulation, videoclip for instructional education, and presentations may be used in the instructional design of virtual labs. It is said that theoretical perspective in this design is to deliver an engaging process of learning for our learners with the use of online learning content where internet connection is available in any possible and convenient time and place. Students can repeat online experiments in the virtual lab at a lower cost and in harmless learning environment than in physical labs (Brinson, 2015).

Virtual Lab in Learning Physics

Science is a subject that demands the implementation of different series of laboratory activities. An idea that covers natural phenomena that involves inquiry and then discovery by means of different possible hands-on activities and experiments guided by teachers (Irwanto, 2017). The laboratory activity allows the demonstration of various hands-on activities which is much more important in science learning. The laboratory activity is anticipated to support the students in obtaining technical skills. By means of implementation of experimental activity in the class, the learners will have first-hand experience, development of conceptual understanding, and promote long-term memory. Currently, many experiments can be carried out involving the advancements in the information technology application (Schwalbe, 2015). The advancement of the computer age when it comes to technology has a variety of beneficial effects on the success of the learning process in education. The idea of technology as exchange to the existing devices, materials, process, system and tools to enable the possibility of interactive laboratories in the different form of schools. Virtual laboratory made a wonderful impact in education during computer age. The use of tools that can be easily learned, and more accurate results are obtained. The virtual lab allows direct visualization on demonstrating experiment, a very interactive virtual environment, close to actual or real experimentation, and achieve an efficient way of executing experiment. Through the virtual lab activity, the learners have the numerous opportunities to redo the incorrect experiment and expand the experience independently. As observed, virtual labs offer various benefits in accomplishing the learning outcomes. The implementation of virtual laboratories in the class lesson answers some of the problems come across in conventional or traditional laboratory. It gives an opportunity for hands-on learning at a lesser, more secure, and budget wise cost (Irwanto, 2017).

Virtual labs as technological integration provided an efficient setup in classroom experiments in physics because they enabled students to conduct the task individually or with many attempts. According to research they can aid students improve their practical physics knowledge (Bretz et al., 2013). On the other hand, lab work continues to face numerous challenges, such as the expensive total cost of all the required equipment and materials, as well as the dangers associated while working with hazardous tests and try-outs while during the lab activities (Kapting'el&Rutto, 2014). But with proof given and presented in literature that the integration to the application of technology, such as simulations animation videos and visualizations with real practical work is very promising (Hofstein& Kind, 2012). Combining a virtual lab with a conventional actual lab is one way to utilize computer advancement in a learning physics lab (Darrah et al., 2014). A virtual lab is project in a virtual environment which includes a set of laboratory execution and videos which enables to demonstrate practice virtually accessible in lab via online (Bajpai, 2013) and has high ability to support and enhanced actual practical-based learning (Darrah et al., 2014; Sullivan et al., 2017). Learners can be able to learn scientific concepts in this way and gain new skills with the help of virtual laboratory in their most convenient time and place through laptops and cellular phones (Ramesh, 2019). Students will minimize their errors in performing a virtual lab with a minimal bad consequences than in a physical or actual lab improving their self-trust to perform in delivering an actual and tangible work experiments furthermore a non-real can assist learners in conducting virtual activity experiments that would be hard to conduct in a real lab due to the absence of available equipment which are considered as an expensive materials and/or non-safe scenario furthermore virtual labs as observed allows students in their science to observe visual illustration such real-life scenario and data collection, infer predictions and allowing their minds to create hypotheses allowing them to participate actively in scientific inquiry processes (Sypsas et al., 2019). Virtual labs had a significant impact on the knowledge, skills, behavior, and level of achievement according to the findings furthermore numerous studies conducted have illustrated that virtual experiments helped students improve their practical skills which was reflected in their actual demonstration in the real lab (Alneyadi, 2019). More precisely, Aljuhani et al. (2018) discovered that non-actual experiment was claimed to be an excellent virtual interface since it assists the learners in performing experiments independently and with multiple tries as necessary. Previous study showed that virtual labs utilization has a mostly positive effect on students' practical physics learning (Sypsas et al., 2019).

Lab Experiments and Students' Achievement

The integration of virtual laboratory experiments to elevate the level on students' mastery and high outcomes and knowledge acquisition has been studied by numerous researches showing that virtual lab experiments increased students' achievement (Alneyadi, 2019; Penn & Umesh, 2019; Pyatt& Sims, 2012; Tatli&Ayas, 2013; Yang & Heh, 2007) while other studies' results showed no difference in their achievement (Crandall et al., 2015; Darrah et al., 2014; Klahr et al., 2007). The impact of computer-simulated laboratory works on the learners academic attainment results in actual physics was explored by Adegoke and Chukwunenye (2013) there are more than one group solely hands-on experiments computer-simulated experiments combined with hands-on experiments and computer-simulated laboratory works only the results demonstrated that of the setups who studied utilizing computer-simulated lesson and practical exercises fared the best in studying the projected outcome in the use of technology integration in experiment on student's learning outcomes in practical physics. They elaborated that the computer-simulated the development of the critical and logical reasoning effect and reported to reduce the abstract nature of physics which will attract students to learn physics.

Furthermore, Tarng et al. (2014) reported the high teaching effectiveness of virtual MFM lab and good improvement of learning achievements in learning physics. Students give positive evaluation towards the learning contents, interface design and operational experiences of using a virtual lab.

Challenges of Technology Integration such as Virtual Lab

Virtual lab projected both advantages and disadvantages result in education. For instance, it dissuades pupils from getting to know actual tools and instruments. The remote access characteristics in virtual laboratory tutors deter direct collaboration and engagement in regard to transferable skills like class interaction that is frequently identified and taught in traditional laboratory training (Chan &Fok, 2009).

Moreover, numerous mishaps that technology integration in education. Challenges reported by Kay et al. (2018) among them were navigational issues and lack of control of over the choice of content and a failure to grasp specific ideas.

As stated by Mazhar (2021), one of the best features of computer is high quality performance, which is not present and become the most occurring issues during the installation and good operation of educational software. Very poor efficient performance of computer is another most common problems with installing and running applications, since it's hard to obtain due to cost.

Comparison of Conventional Lab and Virtual Lab

Researchers have proposed that simulation laboratory environments are superior to traditional lab activity in demonstrating certain scientific experiments due to their distinct characteristics (Bonser et al., 2013). Simulation laboratories contain comprehensive resources, equipment, and other tools that aid in the academic attainment process and make it more visually attractive to students. Furthermore, the simulation laboratory encourages work-collaboration and peer learning.

Theoretical Framework

This research was based on the Pragmatism Theory (Dewey, 1938). Pragmatism, also known as Experimentalism, emphasizes the practical value of cognition while promoting the experimental method of science. Experimentalism present the concept that cognitive behavior is always a sort of testing of preliminary discoveries and hypotheses. Students are more likely to be engaged and interested in what is being taught when they participate in laboratory experiments. Problem-solving and fostering democratic procedures are the most profitable teaching strategies in the current trend of education in the world now. Student-centered activities, a focus on content, and democratic way of handling the classroom are all part of the pragmatic method. Dewey suggested that learners perform well in environments that promote first-hand experience and that very much aligned with the formulated curriculum and activate the general personal participation of each learner.

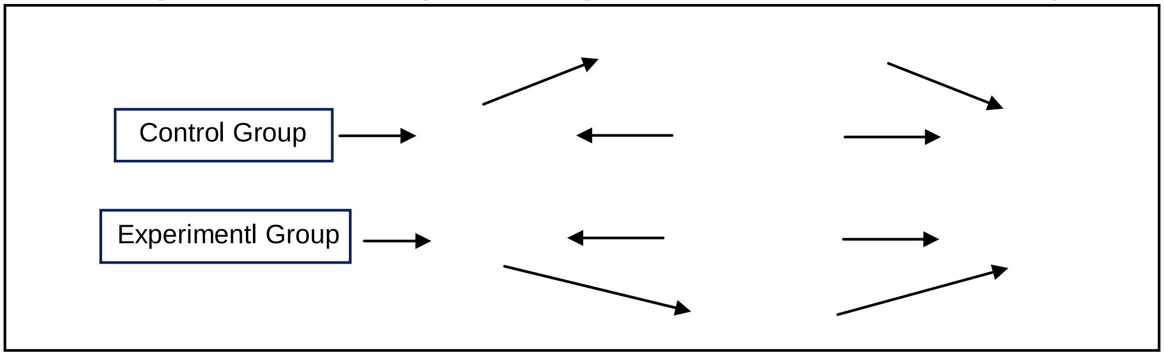
Education Theory of John Dewey suggested that each person who possess high thinking capacity have a similar perception on educators his ideal about a place where education occurs was very much alike to democratic values. As stated by Dewey, it is the collective experience of each person and the person who taught them both affects those values.

Conceptual Framework

The schematic diagram of this study is shown in Figure 1 which shows the comparison between the control group and experimental group between and within the pretest and posttest. The two groups are designated as follows: (1) experimental group, using the Labster (interactive virtual lab) intervention in experimental activity in explore/ learning task part of the lesson plan, and (2) control group, using the conventional way of learning.

In the experimental group, students who used Labster in their physics class, while the control group received no intervention. The difference between the performance (students' scores) on the topic presented is the gain score.

Figure 1:-The Schematic Diagram Shows the Comparison of Gain Score Between the Experimental (Labster) and Control Group (Conventional Learning) and the Comparison within the Pretest and Posttest in Physics.



Hypotheses of the Study

H_{01}. There is no significant difference in the mean pretest scores of students applied with Labster (experimental group) and those with no application of the strategy (control group).
H_{02}. There is no significant difference in the mean posttest scores between experimental group and control group.
H_{03}. There is no significant difference within the pretest and posttest scores in experimental group.
H_{04}. There is no significant difference within the pretest and posttest scores in control group.
H_{05}. There is no significant difference between the mean gain scores of the experimental group and the control group.

Methodology:-

This chapter presents the research design, the respondents, the sampling method, the locale of the study, respondents, the research instruments and its administration, the data gathering procedure and the method of data analysis.

Research Design

This study is a quasi-experimental research that uses The Randomized Pretest–Posttest Control Group Design, Using Matched Subjects. It consisted of two groups, experimental and control group. The two groups were considered comparable and equivalent where pretest scores resulted in no significant difference.

The research design used in the study is illustrated by the following figure:

Experimental Group O_1 X O_2

_ _

Control Group O_1 O_2

where: O_1 = pretest of the experimental and control group
O_2 = posttest of the experimental and control group
X= intervention of the experimental group

The two groups took a teacher-made test served as pretest prior to the conduct of the study. The same test was used as a posttest after the end of the intervention and was given in the experimental group and in the control group.

Locale of the study

Dungoan High School was established in the year 2019 with school ID No. 305794. It is located two (2) kilometers north of the eastern part of the Municipality of M'lang and twenty-five (25) km from Kidapawan City. It is bounded by Barangay Inas on the north, Barangay Poblacion B on the east, and Barangay Dugong on the south. The school's 5000 square meters of land is not yet fenced. Dungoan High School is situated in a relatively tranquil spot, providing a favorable locale for learning and teaching. The school is located 5 kilometers away from the public market of M’lang. The nearest public elementary school is Dungoan Elementary School, which is 500 meters away. At present, the school population is composed of one school head, seven faculty members, and three thousand twenty-seven students.

Location

Figure 2:-Map of M'lang North Cotabato.

Brief Profile

This research focused to the utilization of Labster as interactive virtual laboratory in a new establish public secondary school with no formal classroom building and the absence of physical laboratory facilities, equipment and tools. A Labster is an interactive virtual format which allows the respondents to practice and demonstrate a real-like experiment in physics. It tries to explore how much it can provide in the learning benefits of the respondents in their performance in learning Physics. It provides an alternative way of teaching physics in Grade 10 students for schools who have lacking physical laboratory room and to carry out the lesson activity found in the science curriculum guide provided by the DepEd.

Respondents of the Study

The participants in this study were forty (40) Grade 10 students who currently enrolled for the S.Y. 2022-2023 in Dungoan High School which was considered as new-established school with no classroom building and no laboratory facilities and equipment. According to their age group, these students were between the ages of 15-16. All of the participants were randomly selected. Both control group and experiment group were consisted of twenty (20) respondents.

Sampling Method:-

The researcher selected a total of forty (40) Grade 10 students of Dungoan High School. It used The Randomized Pretest–Posttest Control Group Design, Using Matched Subjects. The subjects in the experimental group were matched based on their grades from the previous grading period to the control group. There were twenty (20) students who were assigned to experimental group with access to virtual lab. Also, twenty (20) students from the other section were assigned to the control group, whose grade were matched with the grades of the experimental group.

Materials:-

The materials utilized by the researchers in this study is teacher-made summative test, which consisted of 25 multiple-choice questions specifically in physics and 5 open ended questions. Two resources will be used to construct the questions, "Grade 10 Science Learning Materials and "Science Curriculum Guide" or the MELCs (Most Essential Learning Competencies) by the DepEd. Items were chosen and modified from the resources.

Other sources utilized for the implementation of the intervention was the Labsters. The researcher developed a contextualized activity from the Labster to achieve the same learning goal found in the science curriculum guide and learning materials of grade 10 from the DepEd.

Research Instrument

The researcher developed a teacher-made 40-item test that underwent content validation and pilot testing. It served as a tool to measure the pre-test and posttest scores of the respondents. This tool was useful since it allows researcher to achieve his goals and determine whether or not the strategy was effective. Students' prior knowledge was determined by the pre-test, and their obtained information was determined by the post-test. This allowed the researcher to see if there is a significant difference in the respondent's performance. All questions were based on the science content that existed in the Science Learners Materials of DepEd which primarily align to the MELCs (Most Essential Learning Competencies) of Grade 10 Science.

After the implementation of the strategy, the respondents were given a survey questionnaire to determine their perception on the Labster in terms of the learning contents, interface design and operating experiences in learning physics. The researcher adopted and modified the satisfactory survey from the virtual MFM laboratory published in the International Journal of Media & It's Application (JJMA) Vol. 6, No. 1, February 2014. Finally, they were asked about the challenges they encountered while using the intervention which is the Labster as interactive virtual lab.

Data Gathering Procedure

The researcher planned first on how to conduct the intervention of using Labster as interactive virtual lab during the explore/learning task part of the lesson when conducting experimental activity.

Figure 3 shows on how the researcher implemented the used of Labster in his class including the preparation, conduction and collection of data.

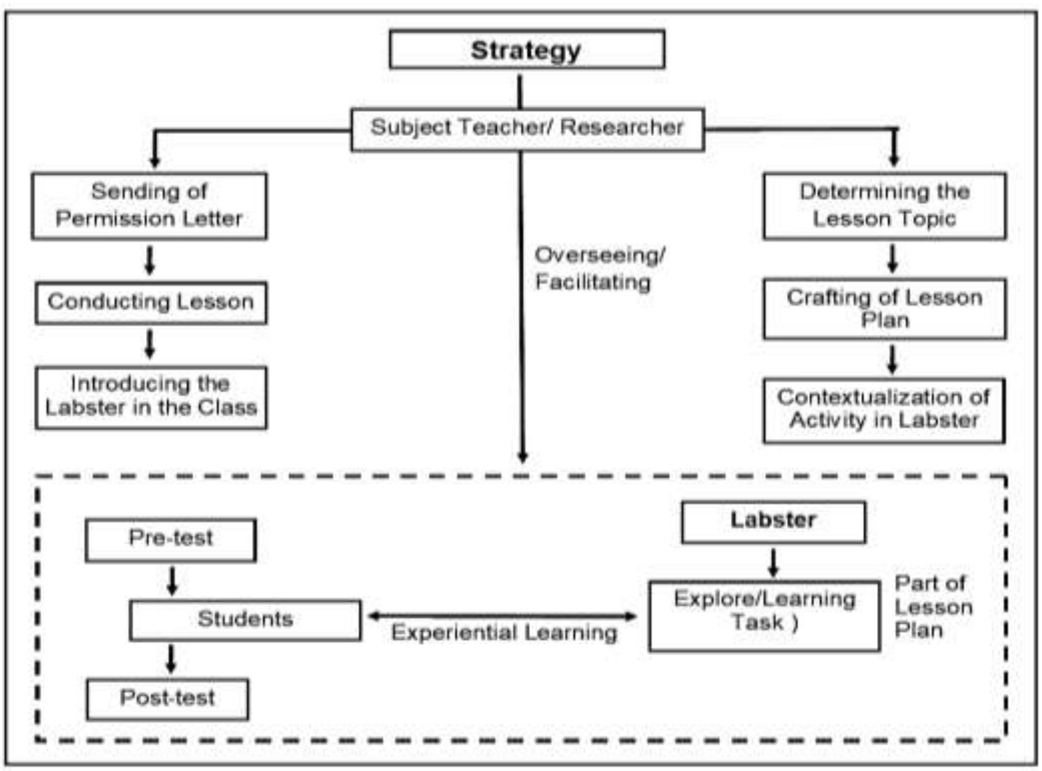


Figure 3:-Flow of the Implementation of Labster Utilization in Physics Lesson.

The researcher utilized the Learning Material of Grade 10 Science from the Unit 2 that focuses on the topic Physics, consisting electromagnetic spectrum; light (including mirrors and lenses); and electricity and magnetism. All lessons and lab activities taught were found on the learning materials.

Table 1 shows the list of content with its subtopics. Including how many days each subtopic was taught to the respondents and how many times the Labster was used in each subtopic.

Table 1:-List of Content, Subtopic, No. of Days Taught and No. of Times the Labster use Each Topic.

Content	Subtopic	No. of Days Taught	No. of Labster Utilization
1.)-Electromagnetic Spectrum	• EM waves • Application of EM waves	3 3	2 2
2.)-Light	• Reflection of Light in Mirrors • Refraction of Light in Lenses	4 3	4 3
3.) Electricity and Magnetism	• Magnetism • Electromagnetic Induction • Electric Motor • Electric Generator	3 2 1 1	2 1 1 1
	Total	20	16

The researcher developed the pre-test and post-test that were checked and validated by a subject specialist and test construction specialist in science and a survey questionnaire that underwent pilot testing. The teacher-made 40-test item was used to determine their learning performance of the students. Moreover, the subjects in the experimental group were matched based on their grades (in second grading) to the control group.

Letter of permission was given and secured from the school head's office. Upon the approval, the pre-test was conducted to the forty (40) selected respondents before the strategy was given. The pre-test was retrieved and kept immediately. The control group used conventional learning while Labster was applied in the experimental group.

Figure 4 shows how the researcher, as the subject teacher of the class, formulated the lesson plan which utilized Labster in the explore/ learning task part of the lesson that requires experimental activity.

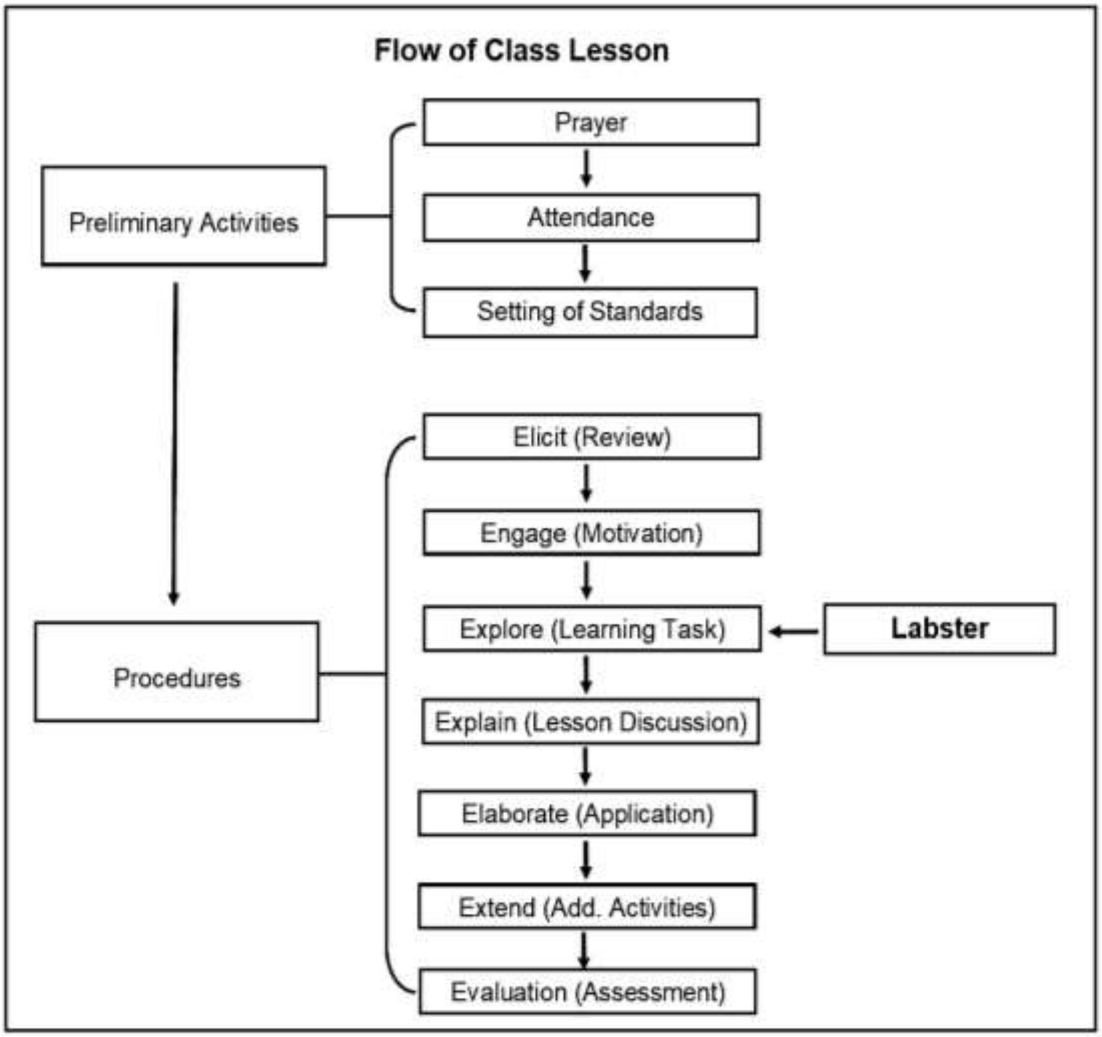


Figure 4:-Flow of Lesson Activity in the Utilization of Labster in Physics Class.

Table 2 shows the different flow of lesson procedures used by the teacher/researcher between the control group and experimental group, specifically in the explore/ learning task part of the lesson.

Table 2:-Difference Between Control Group and Experimental Group in Lesson Plan Procedures.

Control Group	Experimental Group
Elicit (Review)	Elicit (Review)
Engage (Motivation)	Engage (Motivation)
Explore (Learning Task) **(Conventional Learning)**	Explore (Learning Task) **(Utilization of Labster)**
Explain (Lesson Discussion)	Explain (Lesson Discussion)
Elaboration (Application)	Elaboration (Application)
Extended (Additional Activity/ies)	Extended (Additional Activity/ies)
Evaluation (Assessment)	Evaluation (Assessment)

Table 3 shows the different activities used in the control group utilizing the conventional learning only with the absence of formal classroom, laboratory room, tools and equipment. Moreover, the activities found in the Labster for the experimental group were contextualized and modified.

Table 3:-Different Activities Given Between the Control Group and Experimental Group in the Learning Task.

Content	Learning Task of Control Group (Conventional Learning)	Learning Task of Control Group (Utilization of Labster)
1.) Electromagnetic Spectrum -Different Waves of the Electromagnetic Spectrum -Application of Electromagnetic Spectrum	-Describing the EM waves using the picture. - Listing and discussing the different application of EM waves	-Observe the simulation of how does each EM waves behave. -Identify the application of each EM waves using a simulation found in the Labster.
2.) Lights -Mirrors -Lenses	-Drawing a diagram on how the image form in the plane mirror, convex mirror and concave mirror. -Drawing a diagram on how the image form in the convex lens and concave lenses.	-Discover the image form in front of the plane mirror, convex mirror and concave mirror using simulation tool by changing the position objects in front of the mirrors. -Discover the image form in the convex lens and concave lens using simulation tool by changing the position objects in the different lenses.
3.) Electricity and Magnetism - Principle of Magnetism - Electromagnetic Induction - Electric Motor - Electric Generator	-Drawing a diagram about repulsion and attraction reaction of the magnet. -Infer what will happen to the given object with the magnet using video clips. -Explain the table about electric fields, forces and energy - Familiarize and arrange the steps on how to make your own electric motor. -Draw an illustration about electric generator showing coils or closed loops of conductors move through magnetic lines.	-Simulate the repulsion and attraction reaction using different virtual objects in the Labster. -Observe how does the magnetic lines forms in the different side of the magnetic poles. -Simulate how the magnetic field lines change around the magnet and the other objects. -Show how does electric motor works. -Connect the different virtual parts of electric motor to work. -Show how does electric generator works. -Connect the different virtual parts of electric generator to work.

The school head checked the lesson plan. The lesson was conducted to the experimental group and then was introduced to the class on how to use the interactive virtual lab. The researcher provided time for the students to explore and practice on how to use the virtual lab. The utilization of Labster was applied only during the explore or activity part of the lesson to allow students to discover the lesson and conduct scientific method and experimental. In this study, Labster software application/website was used. In the absence of the physical classroom, Labster provided a virtual room for the students to conduct their laboratory activity. Since there was no physical laboratory tools and equipment, this virtual lab provides a virtual tools and equipment and simulation in order for them operate and conduct the experiment same as the real one. The researcher selected and matched a simulation in the laboratory experiment found in the Labster that were suited to the lab activity found in the learner's material. Modification of instruction in the Labster was done to achieve the learning objectives. Each lesson had sixty (60) minutes and twenty (20)- thirty (30) minutes of the entire class covered for lab activity utilizing the Labster. Based on the science curriculum guide, the whole lesson was taught within 20 days. The researcher implemented the strategy from Monday-Thursday only. The whole implementation of the strategy was last 5 weeks only, which was equivalent to one (1) month period. The respondents of this study used smartphone/computer laptop that was connected to the school Wi-Fi to run and operate the Labster.

Figure 5.a shows an example on the virtual experiment in showing the electromagnetic spectrum. It illustrates how to classify waves in electromagnetic spectrum.

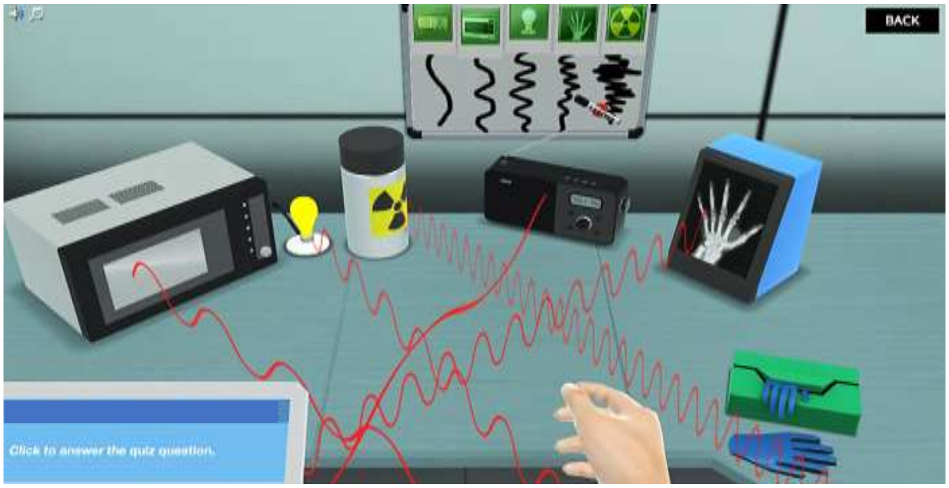


Figure 5.a:-Labster Virtual Experiment on Electromagnetic Spectrum.

Figure 5.b shows an example on the virtual experiment in showing the magnetic field in the magnet. It illustrates how the magnetic lines extend and it's the direction from two opposing pole of magnet.

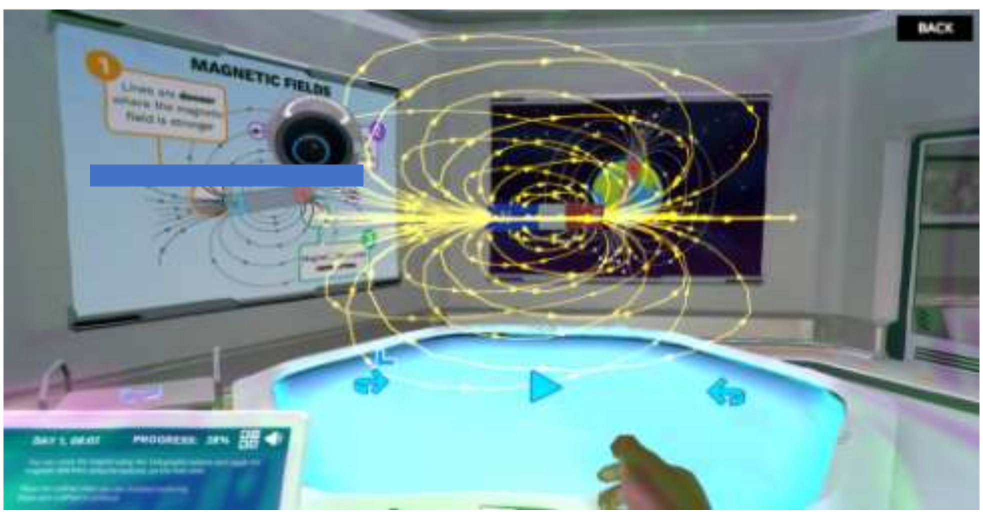


Figure 5.b:-Labster Virtual Experiment on Electricity and Magnetism.

After the implementation of the strategy, post-test was conducted both control and experimental group. A survey questionnaire "agreement survey" was administered to the experimental group to determine the perception of the experimental group when using virtual lab during the laboratory activity. In addition, they were asked about the difficulties they encountered during the utilization of Labster in their lesson. The collected pre-test and post-test were checked. The data was recorded and encoded in the laptop. The five (5) point scale was used with the appropriate mean interpretation and descriptive rating from 1 to 5. To ensure accurate results, the researcher sought the help of statistician (thesis adviser). The results were analyzed and interpreted accordingly.

Method of Data Analysis:-

Statistical tools such as Wilcoxon Signed Rank test, and Mann-Whitney U test are all non-parametric were utilized to assess the differences in mean ranks of scores which fall to a non-normal distribution and the Cliff's D was utilized for the size effect.

Mann-Whitney U test, was utilized in order to assess the mean gain score of control (conventional learning) and experimental group (utilization of Labster) as well as to evaluate the students' performance.

In addition, to determine the perception of students with the utilization of Labster in learning physics in terms of learning contents, interface design and operating experiences. The researcher adopted the survey of the virtual MFM laboratory from the International Journal of Media & It's Application (JJMA) Vol. 6, No. 1, February 2014. Modification was done by the researcher in order to suit the research problem.

Table 4 shows the Likert Scaling for research data analysis to interpret the level of agreement by Pimentel (2010) on the utilization of Labster during the explore/learning task of the experimental group in their physics class.

Table 4:-Scoring Range of Likert Scale of the Survey.

Average Weighted Mean Range	Descriptive Equivalent (Level of Agreement)
4.20-5.00	Strongly Agree
3.40-4.19	Agree
2.60-3.39	Neutral
1.80-2.59	Disagree
1.00-1.79	Strongly Disagree

Results And Discussion:-

Normality Test

This study uses the gain scores to compare the effectiveness of the two teaching strategies. It also analyzes the pretest to posttest gain score to compliment the results. The gain scores were derived from the difference between pretest and posttest score. The figure 6 shows distribution of the collected data and were examined to see if they normally distributed by using visual representation only. Result shows that both the data found in the experimental and control group in the pretest, posttest and gain scores are not normally distributed.

Based on the histogram plots and the Shapiro-Wilk test, the assumption of normality of pretest, posttest, and gain score was considered to be untenable since they do not have achieve the bell shapes of a normal distribution. In addition, most of the z scores for skewness in Table 6 do not fall inside the ± 1.96 range, which are the critical z-score for the large sample size 30 or more, to pass the normality assumption for a significance level of 0.05 (Corder& Foreman, 2009). Furthermore, according to Leech and Onwuegbuzie (2002), the z scores outside the ± 3 range imply the data departed significantly from normality. Finally, since the p-values for the Shapiro-Wilk tests are less than 0.001 for all score types as shown in Table 5.

Figure 6:-Histogram of Pretest, Posttest, Gain Score of Two Groups. The Left Column Shows the Pretest, Posttest, Gain Score of Control Group. The Right Column Shows the Pretest, Posttest, Gain Score of Experimental Group.

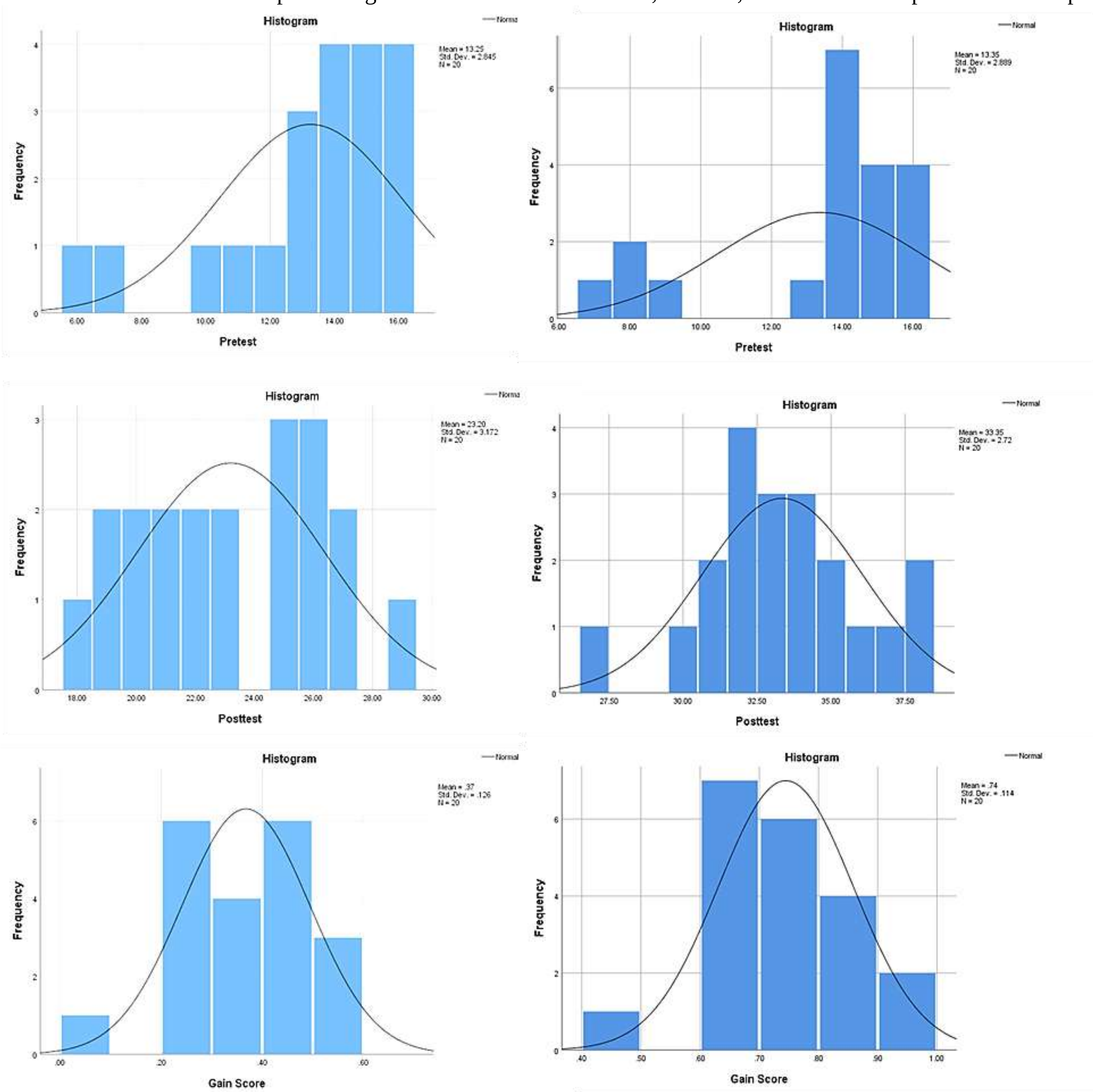


Table 5:-Descriptive Statistics Results of Pretest, Posttest, and Gains Scores.

	Control Group			Experimental Group		
	<Pre>	<Post>	g-ave	<Pre>	<Post>	g-ave
N	20	20	20	20	20	20
Mean	13.25	23.20	0.37	13.35	33.35	0.75
Std. error of the mean	0.64	.71	0.03	0.65	.61	0.03
Minimum	6.00	18.0	0.08	7.00	27.00	0.46
Maximum	16.00	29.0	0.59	16.00	38.00	0.94
Median	20.00	23.0	0.37	20.00	33.00	0.75
Percentiles	`12.25	20.25		13.25	32.00	

25th						
50th	14.00	23.00	0.37	14.00	33.00	0.74
75th	15.00	26.00	0.47	15.00	35.00	0.81
Std. error of skewness	0.512	0.512	0.512	0.512	0.512	0.512
Z	2.337	-1.009	5.0	2.302	-4.908	2.238
Kurtosis	1.641	-1.129	-0.185	0.445	0.426	0.839
Std. error of kurtosis	0.992	0.992	0.992	0.992	0.992	0.992
Z	2.811	0.033	-.596	2.607	0.293	-0.751
Shapiro-Wilk Statistic	0.83	0.95	0.98	0.76	0.97	0.96
df	20	20	20	20	20	20
Sig.	0.003	0.424	0.920	0.000	0.665	0.589

Subsequently, since distributions are considered not normal, the pretest, posttest, and gain scores are studied using nonparametric statistics. Since these tests don't rely on normal distribution, the Wilcoxon Signed Rank test and Mann-Whitney U test, which are non-parametric equivalents of the paired Student's t test and independent t test, respectively, are used to assess differences in mean ranks of scores (Corder& Foreman, 2009).

Moreover, the statistically significant nonparametric results, this study on the effect of utilizing interactive virtual lab in learning physics also reports the effect sizes of the differences between groups' means. As parametric effect sizes, such as Cohen's d and Hedges' g, are distorted by non-normality and heterogeneity of variances, the application of nonparametric effect sizes such as Cliff's d and the like for nonparametric statistical analyses were supported by many researchers (Macbeth el al., 2011). This study utilizes the nonparametric effect size with Cliff's d. The mathematical result of the effect size Cliff's d was carried out by using the package "Effsize" by Torchiano (2014) inside the R environment. According to Romano et al. (2006) guideline, it indicated that an effect size $|d| < 0.147$ is as negligible, $0.147 < |d| < 0.33$ as small, $0.33 < |d| < 0.474$ as medium, and $|d| > 0.474$ as large.

Analysis with Pretest and Posttest Scores

Table 5 also provides the means and medians of pretest and posttest scores for the control group (conventional learning) and the experimental group (utilization of Labster). In this study, data shows both the median and mean scores because the use of median score is more appropriate for non-parametric statistics. As a consequence, the dispersion of scores is quantified in inter quartiles range (IQR) along with the median scores. The dispersion of the mean scores, the standard deviation (SD), is not reported because the distributions of scores were highly skewed. All the median and mean scores are reported in percentage and calculated at a 95% confident interval. All statistical tests are calculated at a significance level of 0.05.

As the study employs The Randomized Pretest–Posttest Control Group Design, Using Matched Subjects, the pretest scores of the control group (conventional learning) and the experimental group (utilization of Labster) were compared first to see whether the two groups were equivalent at the beginning of the study. The result of the Mann Whitney U test (Table 6) indicates no statistically significant difference in the pretest scores between the two groups ($U = 188.000$, $p = 0.741$). This confirms that the two groups were equivalent at the beginning of the study.

The result of the pretest implied that both experimental and control group had difficulties especially in understanding concept of physics due to the absence of experimental and laboratory activities in the class (Chen, 2022). As cited in the study of Pareek (2019); de Borja and Marasigan (2020), newly established schools lack laboratory facilities and equipment which led to the science teacher not to conduct lab activity that leads to poor understand of the physics concepts.

For the posttest scores, the Mann-Whitney U test reveals that the mean rank posttest score of the experimental group which applies Labster as interactive virtual lab ($M = 33.35 \pm 0.61$) is statistically significantly higher ($U = 2.000$, $p< 0.001$) than that of the control group which utilizes only the conventional way of learning ($M = 23.20 \pm 0.71$). This result shows that there is a great significant difference between the two groups after the implementation of strategies. This also mean that the increase in the posttest scores demonstrates a positive impact of the utilization of Labster in teaching physics in explore/learning task of the lesson in the experimental group when compared with in the control group which there is no application of technology integration.

The utilization of Labster as interactive virtual lab resulted to the increased of performance of the experimental group. It showed that the use of interactive virtual lab improved their practical physics knowledge (Bretz et al., 2013). Studies shows that virtual lab experiments increased students' achievement (Alneyadi, 2019; Penn & Umesh, 2019; Pyatt& Sims, 2012; Tatli&Ayas, 2013; Yang & Heh, 2007).

Table 6:- Mann-Whitney U Test Results for Pretest and Posttest Scores Differences.

	n	Mean Rank	Sum of Ranks	Mann-Whitney U	z	Asymp. Sig. (2tailed)	Effect size
Pretest score Control Group	20	19.90	398.00	188.000	-0.331	0.741	0.003
Experimental Group	20	21.10	422.00				
Posttest score Control Group	20	10.60	212.00	2.000	-5.365	0.000	0.738
Experimental Group	20	30.40	608.00				

Note. Cliff's d = 0.003 is considered as negligible and d = 0.738 as large.

One more non-parametric statistical test, the Wilcoxon Signed Rank test, was performed to tell whether there was a statistically significant difference between pretest and posttest mean rank scores within the two group. The similar the paired t test in parametric statistics is Wilcoxon Signed Rank test. The result in Table 7 shows statistically significant difference between the mean rank posttest scores ($M = 23.20 \pm 0.71$) and the mean rank pretest scores ($M = 13.25 \pm 0.64$) of the control group (conventional learning) ($W = 0.00$, $n = 20$, $p < 0.001$). Likewise, based on the difference between the mean rank posttest scores ($M = 33.35 \pm 0.61$) and the mean rank pretest scores ($M = 13.35 \pm 0.65$) of the experimental group (utilization of Labster) also reaches statistical significance ($W = 0.00$, $N = 20$, $p < 0.001$). Moreover, the sums of the positive ranks are larger than the sums of the negative ranks in both cases ($\Sigma R+ = 210.0$ versus $\Sigma R- = 0$ both in the control group (conventional learning) and experimental group (utilization of Labster), demonstrating the positive impact of the two learning strategies. That means learning with conventional learning and utilization of Labster as interactive virtual lab helped students improve their scores from pretest to posttest. However, because the effect size of the difference in the mean test scores of the experimental group with the utilization of Labster as interactive virtual lab ($d = 0.878$) is much larger than that of the control group with no application of technology integration ($d = 0.657$), the instruction with Labster as interactive virtual lab is slightly effective than the conventional learning in increasing students' posttest scores. This outcome offers yet another piece of proof supporting the benefits of technology integration in physics education.

Table 7:- Wilcoxon Signed Rank Test Results for Pretest and Posttest Scores Differences.

	n	Mean Rank	Sum of Ranks	z	Asymp. Sig. (2tailed)	Effect size
Control Group Negative Ranks PositivenRanks<Post > - <Pre>	0 20	0.00 0.00	0.00 210.0	-2.936	0.00	0.657
Ties	0					
Total	20					
Experimental Group Negative Ranks PositivenRanks<Post > - <Pre>	0 20	0.00 10.50	0.00 210.0	-3.928	0.00	0.878

Ties	0					
Total	20					

Results and Analysis with Gain Scores:-

The results of the gain mean rank score with the Mann-Whitney U test, Table 8 show that the overall mean gain rank scores of the experimental group (utilization of Labster) ($M = 0.75 \pm 0.03$, $n = 20$) is significantly higher than that of the control group students (conventional learning) ($M = 0.37 \pm 0.03$, $n = 20$), with $U = 5.500$, $z = –5.262$, $p < 0.001$. That means the utilization of Labster in physics class is effective in improving students' learning gains. The Cliff's effect size $d = 0.71$ of the mean learning gain difference is considered as large according to Romano et al. (2006).

This finding supports the idea presented by Hofstein and Kind (2012) on the integration of technology specifically of using interactive virtual lab. They said that it was considered appropriate to be developed in teaching physics, as it helps the students to become motivated learners and learn self-independency in learning. Virtual labs had a significant impact on the knowledge, skills, behavior, and level of achievement (Alneyadi, 2019). It enables learners to have a comprehensive scope in learning process as can be seen in the result of the mean gain scores of experimental and control groups.

The significant difference result between the mean gain rank scores of experimental and control groups for this study was similar to the findings of the study conducted by (Bretz et al., 2013). They asserted that by using technology application, it allows the students to explore concepts through visual representation and improve their practical physics knowledge.

Table 8:- Mann-Whitney U Test for Learning Gain of Two Groups.

Group	n		Mean Rank	Sum of Ranks	Mann-Whitney U	z	Asymp. Sig. (2tailed)	Effect size
Control Group	20		30.23	604.50	5.500	-5.262	.00ˆ 47	0.71
Experimental Group	20		10.78	215.50				

Qualitative Study

This section presents the students' perception on the effect of utilizing interactive virtual lab on students' performance in physics using Labster and the difficulties encountered by the respondents while using intervention.

Results of Students' Perception of Utilizing Labster

Table 9.1 shows that students agreed that the utilization of Labster is a great interactive virtual lab (items 1, 2, 5, and 6) in terms of learning contents with a weighted mean of 4.08.

Table 9.1:- Perception of Students Exposed to Labster in Learning Physics in Terms of Learning Contents.

Question	Mean Score	Description
1. I understand most of the textual descriptions in the Virtual Lab.	4.41	Agree
2. The images in the virtual lab are clear.	4.45	Agree
3. The virtual lab can respond to my operation quickly.	3.55	Agree
4. The virtual lab provides adequate prompts.	3.9	Agree
5. I understand the steps of operating procedures after using the virtual lab.	4.05	Agree
6. I actively completed the tasks.	4.4	Agree
MEAN	4.08	Agree

Table 9.2 reveals that students agreed that the utilization of Labster has good visual representation (items 1, 2, 3, 4, and 5) in terms of interface design with a weighted mean of 4.34.

Table 9.2:- Perception of Students Exposed to Labster in Learning Physics in Terms of Interface Design.

Question	Mean Score	Description
1. The operation of virtual lab is closer to reality.	4.70	Strongly Agree
2. The text in the virtual lab is easy and clear.	4.55	Strongly Agree
3. The verbal prompts in the virtual lab are simple and easy to understand.	4.60	Strongly Agree
4. I feel the intuitive to operate the virtual lab.	4.00	Agree
5. The visual design of the virtual lab is delightful and consistent.	4.85	Strongly Agree
6. The execution of virtual lab is smooth.	3.35	Neutral
MEAN	4.34	Strongly Agree

Table 9.3 tells that students strongly agreed that the utilization of Labster is good example of interactive virtual laboratory when performing virtual experiment (items 1, 2, 3, 4, 5, and 6) in terms of operational experiences with a weighted mean of 4.72.

Table 9.3:- Perception of Students Exposed to Labster in Learning Physics in Terms of Operational Experiences.

Question	Mean Score	Description
1. Using the virtual lab helps me understand the lesson.	4.90	Strongly Agree
2. Using the virtual lab helps me to perform the laboratory activity virtually.	5.0	Strongly Agree
3. Using the virtual lab makes me want to learn more about physics.	4.60	Strongly Agree
4. After, using the virtual lab, I become more interested in learning physics.	4.75	Strongly Agree
5. The virtual tool/ equipment is easy to use.	4.15	Agree
6. I like to use the virtual lab as interactive material during lab activity.	4.90	Strongly Agree
MEAN	4.72	Strongly Agree

The data above was supported by Tarng (2014) the high teaching effectiveness of virtual lab and good improvement of learning achievements. Students give positive evaluation towards the learning contents, interface design and operational experiences of utilizing a virtual lab.

Difficulties Encountered of Utilizing Labster

While using Labster, the respondents experience difficulties. There are three major themes as presented and reported by the respondents in using the Labster as interactive virtual lab: (1) program incompatibility with lower computer and smartphone processor; (2) incapability to perform tasks with more than two activities at a time; and, (3) insufficient computer literacy.

Program Incompatibility with lower computer and smartphone processor. Labster is a downloadable type of software application that can be operated via online. Another alternative way to access Labster is through an online website. It is reported that this type of software is not compatible in all computer and smartphone processor. This application can be installed and operated only with quad-core program processor or higher both in computer and smartphone.

"The software won't work well with a low processor device. It cannot be installed with a computer or smartphone supported by dual-core processor only. It requires higher spec of operating program to avoid lagging and stuck. $_{(R1,R4,\&R5)}$"

Incapability to execute tasks with more than two activities at a time. Labster is virtual lab that is very much close to reality and can perform simple and basic to complex simulation of laboratory activities. Based on the transcripts provided by the students, in terms executing the task assigned to them. They perform the task one step at a time with step-by-step procedures. The Labster cannot multitask, performing different parts of or kinds of virtual experiments at same time, even using other tabs or windows in the computer. Conducting virtual lab activities in the Labster should be done in sequential manner. $_{(R7\&R18)}$" The same problem was presented by other respondents who narrated "You cannot perform two activities at the same time. $_{(R2\&R20)}$ If there were two or more tasks given, you needed to perform them one by one. If there is a comparison of results in some lab activity, you need to record or take a picture of your first task before proceeding to the next. Which means you cannot compare two results at the same time, demand more time to finish the lab activity and delay of output submission. $_{(R4,R9,R13,\&R17)}$" This problem was supported by other respondents "In some lab activities, there is a tendency to repeat the task if you forgot to record your data, specifically when comparing two or more variables. $_{(R2,\&R7)}$"

Insufficient Computer Literacy. Labster shows concrete representation of concepts in physics. It also shows explanation in abstract form and provide simulation and multiple practice and/or attempts in doing virtual experiments and task. This can be used effectively with complete understanding to the software virtual framework; therefore, the respondents should recognize and understand the function of each tools to demonstrate and navigate the different functions. Prior knowledge in computer usage helped the respondents in conducting virtual labs efficiently. In terms of error in tool selection and misunderstanding of computer commands, the application will automatically give suggestion using voice and text command on how to operate and proceed. Some respondents stated that "Simultaneous display of voice and text command if there is an error in tool selection and longer time duration of being unresponsive to the task. $_{(R8)}$ It is hard to recognize how and which tool or function to use. $_{(R6\&R11)}$ In a virtual lab demonstration, experiencing a lack of knowledge on how to execute the task using the computer or the smartphone. Other reasons are due to the unawareness of the function of some tools. $_{(R9,R11,\ \&R15)}$"

Nonetheless, they also reported that they were able to outweigh the difficulties they encountered by the use of the Labster by letting their peers or groupmates educate them on how to use the Labster or with the assistance of the subject teacher in terms of the operating experiences they had on the computer or smartphone while using the Labster. The result of the posttest with the significant increase in the scores of the respondents in the experimental group proved that mastery of operations was developed in the students. This finding was similar to the notion asserted by Chan and Fok (2009) that the use of virtual lab on students has both a negative and positive effect in learning. In addition, they find the Labster as an enjoyable and meaningful way of learning.

Summary, Conclusions, And Recommendations:-

Summary

The study was conducted to Grade 10 students on the Effect of Utilizing Interactive Virtual Lab on Students' Performance in Physics. Specifically, the study aimed to (1) determine whether there is a significant difference between the level of performance of experimental and control group before the strategy, (2) determine whether there is a significant difference between the level of performance of experimental and control group after the strategy, (3) determine whether there is significant difference within the pretest and posttest scores of the experimental group, (4) determine whether there is significant difference within the pre-test and posttest scores of the control group, (5) determine if there is a significant difference between the gain score of the experimental and control group, (6) determine the perception of the students while using the Labster as interactive virtual lab in class laboratory experiment in terms of learning contents, interface design and operating experiences, and (7) identify the difficulties students encounter while using the virtual lab in class laboratory experiment.

This study is a quasi-experimental research that used The Randomized Pretest–Posttest Control Group Design, Using Matched Subjects. Forty grade 10 students coming from the two different section of section Zeus (experimental group) and Poseidon (control group) of the Dungoan High School. Both groups experimental (utilization of Labster) and control group (conventional learning) have the same process of teaching mode but varied only on the part of explore/learning task of the lesson. The experimental group was taught using interactive virtual lab using Labster and the control group was taught using the conventional way of learning. A validated instrument served as a pretest and posttest was administered to each group before and after the experiment. The collected data were analyzed and interpreted using a non-parameter statistic in this study with the utilization of Labster as interactive virtual lab to assess the differences in mean ranks of scores since the distribution of the scores are not normally distribution and the Cliff's D for size effect. Moreover, to gather data on the perceived learning effectiveness of the Labster, the adopted and modified for the validity questionnaire was used. There are three major themes as presented and reported by the respondents in using the Labster as interactive virtual lab: (1) program incompatibility with lower computer and smartphone processor; (2) incapability to perform tasks with more than two activities at a time; and, (3) insufficient computer literacy.

Summary of Findings:-

The findings of the study are as follows:

1. There is no significant difference between the pretest mean rank score result of the experimental group (utilization of Labster) and control group (conventional learning) which mean ranks the two groups are comparable.
2. There is a significant difference between the posttest mean rank score result of the experimental group (utilization of Labster) and control group (conventional learning).
3. There is a significant difference within the pretest and posttest mean rank scores of the experimental group.
4. There is a significant difference within the pretest and posttest mean rank scores of the control group but not much higher compared to experimental group.
5. There is a significant difference between the gain mean rank score of the experimental and control group.
6. The perception of the students is great while using the Labster as interactive virtual lab in class laboratory experiment in terms of learning contents with a weighted average of 4.08, 4.34 in interface design and 4.72 in operating experiences; and
7. The difficulties encountered by the students in using an interactive virtual lab in class laboratory experiment are (1) program incompatibility with lower computer and smartphone processor (2) incapability to perform tasks with more than two activities at a time; and, (3) insufficient computer literacy.

Conclusions:-

The test of difference in pretest scores between control and experimental group shows no significant difference. This implies that the two groups were comparable in terms of prior knowledge on topics in physics before the study was conducted. There are errors or mistakes in the given tasks that were common to students from both groups which means that they encountered difficulties in understanding concepts in physics virtual lab.

The test of difference in posttest scores between control and experimental group shows a significant difference. This suggests that integrating technology like the used of Labster as interactive virtual lab increases the performance of the students in experimental group (from low to high performance level). The used of Labster may had a contribution in enhancing students' performance in learning concepts on conducting virtual lab because it nurtures positive attitudes to the students in learning physics. This means that the conventional way of teaching by the teacher is effective but not same as with the use of interactive virtual lab. Assistance from teachers and knowledgeable persons on interactive virtual lab such as the Labster is needed to fully maximize the benefits which conventional learning cannot offer.

Furthermore, the test of difference shows that the experimental group has higher mean gain score than the control group. This suggested that the students in the experimental group gained more knowledge from Labster than the students in the control group who did not utilize it. The use of Labster in learning helps the students to be motivated, to learn independently and to have positive attitudes in the physics subject which leads to higher academic performance.

Recommendations:-

Considering the result of the study, the researcher hereby recommends that:

1. Teachers integrate technology especially computer and smartphone and the use interactive virtual lab such as Labster in teaching and learning physics concepts.
2. Labster should be used by the students to explore and understand concepts of physics, especially to those school with no physical classroom, facilities and equipment. It enables them to improve learning that can be used in higher level physics concept and performances in conducting virtual lab experiment in physics that were useful in conducting actual and real lab experiment.
3. Teachers should assist students in operating the interactive virtual lab and give discussions on the result displayed in the computer or smartphone.
4. The use of other interactive virtual lab that is compatible to all computer and smartphones available on the market, can perform tasks with more than two or more virtual lab experiment at the same time to compare result immediately and save time while doing multiple task are recommended.
5. Similar studies be done on a longer range of time and also in a combination of real and actual lab and interactive virtual lab face to improve the strategy and learning. It should be conducted in all grade levels to sustain interest.
6. Trainings and seminars be conducted for science and/ or physics teacher to facilitate learning activities in implementing the uses of computer and smartphone and applications in learning physics.
7. Implementation of traditional/actual lab by using improvised equipment.
8. Physics teachers should also use the combination of traditional lab and virtual lab to increasethe effectiveness of the effectiveness of the learning strategies.

References:-

1. Achuthan, K., Raghavan, D., Shankar, B., Francis, S. P., &Kolil, V. K. (2021). Impact of remote experimentation, interactivity and platform effectiveness on laboratory learning outcomes. International Journal of Educational Technology in Higher Education, 18(1), from https://doi.org/10.1186/s41239-021-00272-z
2. Adegoke, B. D., &Chukwunenye, N. (2013). Improving students' learning outcomes in practical physics, which is better? Computer simulated experiment or hands-on experiment? IOSR Journal of Research & Method in Education (IOSR-JRME), 2(6), 18-26, from https://doi.org/10.9790/7388-0261826
3. Aljanazrah, A. M. (2006). Developing, implementation, and evaluation of a new chemistry teacher in-service training model based on blended learning. Shaker.
4. Aljuhani, K., Sonbul, M., Althabiti, M., &Meccawy, M. (2018). Creating a virtual science lab (VSL): the adoption of virtual labs in Saudi schools. Smart Learning Environments, 5(1), from https://doi.org/10.1186/s40561-018-0067-9
5. Alneyadi, S. (2019). Virtual lab implementation in science literacy: emirati science teachers' perspectives. Eurasia Journal of Mathematics, Science and Technology Education, 15(12), from https://doi.org/10.29333/ejmste/109285
6. Bajpai, M. (2013). Developing concepts in physics through virtual lab experiment: an effectiveness study, from https://ndpublisher.in/admin/issues/tlv3n1f.pdf
7. Bansal, S., Maheshwari, V. K., & Agarwal, S. (n.d.). Pragmatism and education scribd. Retrieved April 4, 2023, from https://www.scribd.com/doc/30853941/Pragmatism-and-Education#
8. Bonser, S. P., De Permentier, P., Green, J., Velan, G. M., Adam, P., & Kumar, R. K. (2013). Engaging students by emphasizing botanical concepts over techniques: Innovative practical exercises using virtual microscopy. Journal of Biological Education, 47(2), 123- 127
9. Bretz, S. L., Fay, M., Bruck, L. B., & Towns, M. H. (2013). What faculty interviews reveal about meaningful learning in the undergraduate chemistry laboratory. Journal of Chemical Education, 90(3), 281–288, from https://doi.org/10.1021/ed300384r
10. Brinson, J. R. (2015). Learning outcome achievement in non-traditional (virtual and remote) versus traditional (hands-on) laboratories: A review of the empirical research. Computers & Education, 87, 218–237, from https://doi.org/10.1016/j.compedu.2015.07.003
11. Chan, C., &Fok, W. (2009). Evaluating learning experiences in virtual laboratory training through student perceptions: a case study in electrical and electronic engineering at the University of Hong Kong. Engineering Education, 4(2), 70–75, from https://doi.org/10.11120/ened.2009.04020070
12. Chen, Y. L., (2022) 3 reasons why students struggle with physics, from https://www.vantagetutor.com/post/3-reasons-why-students-struggle-with physics#:~:text=Physics%20can%20be%20rather%20abstract,most%20students%20are%20not%20convinced.
13. Corder, G. W., & Foreman, D. I. (2009). Nonparametric statistics for non-statisticians: a step-by-step approach. Hoboken, NJ: Wiley.

14. Crandall, P. G., O'Bryan, C. A., Killian, S. A., Beck, D. E., Jarvis, N., & Clausen, E. (2015). A comparison of the degree of student satisfaction using a simulation or a traditional wet lab to teach physical properties of ice. Journal of Food Science Education, 14(1), 24–29, from https://doi.org/10.1111/1541-4329.12049
15. Darrah, M., Humbert, R., Finstein, J., Simon, M., & Hopkins, J. (2014). Are virtual labs as effective as hands-on labs for undergraduate physics? A comparative study at two major universities. Journal of Science Education and Technology, 23(6), 803–814, from https://doi.org/10.1007/s10956-014-9513-9
16. De Borja, J. M., & Marasigan, A. (2020). Status of science laboratory in a public junior high school. ResearchGate, from https://www.researchgate.net/publication/339832401_Status_of_Science_Laboratory_in_a_Public_Junior_High_School
17. Department of Education. (2016). Republic of the Philippines Department of Education K to 12 curriculum guide science (Grade 3 to Grade 10): Author
18. Dewey, J. (1938). Experience & education, from https://www.schoolofeducators.com/wp-content/uploads/2011/12/EXPERIENCE-EDUCATION-JOHN-DEWEY.pdf
19. Falsario, M. J. (2011). Thinking Science I workbook on stu-
20. dents' achievement. [Unpublished Master Thesis], Sul-
21. tan Kudarat State University, Tacurong City, Philippines
22. Falsario, M. J. (2011). Thinking Science I workbook on stu-
23. dents' achievement. [Unpublished Master Thesis], Sul-
24. tan Kudarat State University, Tacurong City, Philippines
25. Flint, S., & Stewart, T. (2010). Food microbiology-design and testing of a virtual laboratory exercise. Journal of Food Science Education, 9(4), 84-89.
26. Hofstein, A., & Kind, P. M. (2012). Learning in and from science laboratories. Second international handbook of science education (pp. 189-207). Springer, from https://doi.org/10.1007/978-1-4020-9041-7_15
27. Hughes, J., (2019). Critical innovators: How teachers and entrepreneurs position themselves as technology innovators in schools, from file:///C:/Users/admin/Downloads/paper_218959.pdf
28. International Journal of Media & Its Application (2014) Satisfactory survey, Vol. 6, No. 1: Author, from https://airccse.org/journal/ijma_current14.html
29. Irwanto, F. R. (2017). Using virtual lab to enhance student's thinking, abilities, skills, and scientific attitudes. Osf.io, from https://osf.io/preprints/inarxiv/vqnkz/
30. Janse, B. (2019). John Dewey theory. Toolshero, from https://www.toolshero.com/change-management/john-dewey-theory/
31. Kapting'el, P., &Rutto, D. K. (2014). Challenges facing laboratory practical approach in physics instruction in Kenyan District secondary schools. International Journal of Advancements in Re-search & Technology, 3(8), 13-17.
32. Kay, R., Goulding, H., & Li, J. (2018). Assessing the impact of a virtual lab in an allied health program. Journal of Allied Health, 47(1), 45–50. https://pubmed.ncbi.nlm.nih.gov/29504019/#:~:text=Challenges%20reported%20included%20navigational%20difficulties
33. Kiboss, J. K., Ndirangu, M., &Wekesa, E. W. (2004). Effectiveness of a computer-mediated simulations program in school biology on pupils' learning outcomes in cell theory. Journal of Science Education and Technology, 13(2), 207-213.
34. Klahr, D., Triona, L. M., & Williams, C. (2007). Hands on what? The relative effectiveness of physical versus virtual materials in an engineering design project by middle school children. Journal of Research in Science teaching, 44(1), 183-203, from https://doi.org/10.1002/tea.20152
35. Labster. (n.d.). Physics virtual laboratory. Labster, from www.labster.com/explore/physics-lab-online
36. Leech, N. L., & Onwuegbuzie, A. J. (2002). A call for greater use of nonparametric statistics.
37. Likert, R. (1932) "A technique for the measurement of attitudes", Archives of Psychology, Vol. 22,
38. No. 140, pp. 1-55
39. Likert, R. (1932) "A technique for the measurement of attitudes", Archives of Psychology, Vol. 22,
40. No. 140, pp. 1-55
41. Likert, R. (1932) "A technique for the measurement of attitudes", Archives of Psychology, Vol. 22,
42. No. 140, pp. 1-5
43. Li, L., Zheng, Y., & Zhong, S. (2011). IWVL: A web-based virtual lab for physics teaching in junior high schools. Computing and Intelligent Systems, 192–199, from https://doi.org/10.1007/978-3-642-24010-2_26

44. Macbeth, G., Razumiejczyk, E., & Ledesma, R. D. (2011). Cliff's delta calculator: A non-parametric effect size program for two groups of observations. UniversitasPsychologica, 10(2), 545-555.
45. Mazhar, A. (2021). Top 8 best features of educational software. CodeLabs Inc., from https://codelabs.inc/2021/03/30/top-best-8-features-of-educational-software/
46. Medialdea, R. L. &Sunawaga, E. (2020). Testing the limits: Integrating physics lab classes with online Learning, from https://thelasallian.com/2020/11/21/testing-the-limits-integrating-physics-lab-classes-with-online-learning/
47. Ministry of Education Advisory Office (2008). Introduction to nanotechnology: a supplementaryteaching material for high school nano courses, Central and Northern Center for K-12 educationaldevelopment in Nanotechnology, Ministry of Education, Taiwan.
48. Pareek, R. B. (2019). An assessment of availability and utilization of laboratory for laboratory facilities for teaching science at secondary level, from https://www.researchgate.net/publication/332662140_An_Assessment_of_Availability_and_Utilization_of_Laboratory_Facilities_for_Teaching_Science_at_Secondary_Level
49. Penn, M., & Umesh, R. (2019). The use of virtual learning environments and achievement i 63 s content tests. In M. Carmo (Ed.), Proceedings of the International Conference on Education and New Development (pp. 493-497). Porto, Portugal. InScience Press.
50. Pimentel, J. L. (2010). A note on the usage of likert scaling for research data
51. analysis. USM R&D Journal, 18(2), 109-112
52. Pyatt, K., & Sims, R. (2012). Virtual and physical experimentation in inquiry-based science labs: attitudes, performance and access. Journal of Science Education and Technology, 21(1), 133-147, from https://doi.org/10.1007/s10956-011-9291-6
53. Ramesh, M. (2019). Virtual lab: A supplement for traditional lab to school students. Research Review International Journal of Multidisciplinary, 4, 434-436.
54. Roblyer, M. & Hughes, D. (2014). Integrating educational technology into teaching, from https://ucarecdn.com/759e0ccc-8fe8-45d7-aa2a-a77218448e0b/
55. Romano J., Corragio J., &Skowronek J. (2006). Appropriate statistics for ordinal level data: Should we really be using t test and Cohen’s d for evaluating group differences on the NSSE and other surveys? In Annual Meeting of the Florida Association of Institutional Research. Cocoa Beach, FL (p. 1–33).
56. Savvides, P., Badillo, J., &Londino-Smolar, G. (2020). 7 things you should know about virtual labs. Library.educause.edu, from https://library.educause.edu/resources/2020/8/7-things-you-should-know-about-virtual-labs
57. Schiller, F. C. S., Pragmatism theory of Schiller, from https://www.jstor.org/stable/2103713
58. Schwalbe, K. (2015). Information technology project management. Cengage Learning.
59. Sullivan, S., Gnesdilow, D., Puntambekar, S., & Kim, J. S. (2017). Middle school students’ learning of mechanics concepts through engagement in different sequences of physical and virtual experiments. International Journal of Science Education, 39(12), 1573-1600, from https://doi.org/10.1080/09500693.2017.1341668
60. Sypsas, A., Paxinou, E., &Kalles, D. (2019). Reviewing inquiry-based learning approaches in 64 laboratory environment for science education. Proceedings of the 10th International Conference in (Distance Learning (pp. 74-89). Athens, Greece, from https://doi.org/10.12681/icodl.2288
61. Tarng, W., Cheng, Y., Lin, C., Lee, C. &Liou, H (2014) Design of a virtual laboratory for analyzing nanoscale magnetic materials, Graduate Institute of e-Learning Technology, National Hsinchu University of Education, Taiwan
62. Tatli, Z., &Ayas, A. (2013). Effect of a virtual chemistry laboratory on students’ achievement. Educational Technology & Society, 16(1), 159-170, from https://www.jstor.org/stable/jeductechsoci.16.1.159
63. Torchiano, M. (2014). Effsize: Efficient effect size computation. Version 0.5.2. Retrieved from http://cran.r-project.org/web/packages/effsize/index.htm
64. Tortora, G., Funke, B. & Case, C. (2019). Microbiology: An introduction 13th edition. Pearson Education, Inc., Boston
65. Verlage, E., Saini, S., Agarwal, A., Serna, S., Kosciolek, R., Morrisey, T., &Kimerling, L. C. (2019). Web-based interactive simulations and virtual lab for photonics education. SPIE, from https://dspace.mit.edu/handle/1721.1/127239
66. Yang, K.-Y., & Heh, J.-S. (2007). The impact of internet virtual physics laboratory instruction on the achievement in physics, science process skills and computer attitudes of 10th-grade students. Journal of Science Education & Technology, 16(5), 451–461, from https://doi.org/10.1007/s10956-007-9062-6.