The Effectiveness of Using Conventional Whiteboard in Teaching Probability and Statistics Online

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ABSTRACT:

Using an instructional aid in teaching Mathematics is important in simplifying the abstract concepts behind numerical expressions. This study determined the effectiveness of using a conventional whiteboard in teaching Probability and Statistics online. It was conducted in the Senior High School Department of Misamis University, Ozamiz City, from 2021-to 2022. Quasi-experimental research, specifically the matching pretest-posttest control group design, was used. The respondents were 40 senior high school students from the Humanities and Social Sciences (HUMSS) Grade 11 classes, with 20 students each for the experimental and control groups. They were selected through a purposive sampling technique. Mean, standard deviation, and t-test were utilized as statistical tools. Findings revealed that before using a conventional whiteboard and PowerPoint presentations as instructional aids, both control and experimental groups had low pretest performance. After implementing the interventions, both groups showed a significant increase in their posttest performance. There was a statistically significant difference in the posttest performances between the control and experimental groups, which revealed that using a conventional whiteboard in teaching probability and statistics led to higher student performance than with PowerPoint presentations. Hence, a conventional whiteboard is a more efficient teaching tool that aids students in effectively learning Probability and Statistics.

KEYWORDS: Conventional Whiteboard, Mathematics Performance, Online Learning, Probability And Statistics

INTRODUCTION

Mathematics is an important academic subject linked to various fields, including science, technology, and engineering (King et al., 2016). In addition, Mathematics completes the triangle of essential academic skills highly valued in both mainstream and special education, together with reading and writing (Vostanis et al., 2021). Moreover, a study conducted in Malaysia about improving students' perception of learning Mathematics revealed that many of the decisions made in persons' daily lives require the ability to compute, solve problems and use mathematical concepts and skills (Kasmin et al., 2019). Furthermore, it aids people in organizing their worldviews and discoveries methodically, such as when they must describe the quantity and spatial connections (Parviainen, 2019).

According to Britanica (2022), Mathematics is a branch of science concerned with structure, order, and relationships that arose from counting, measuring, and describing object shapes. Algebra, analysis,

arithmetic, combinatorics, Euclidean and non-Euclidean geometries, game theory, number theory, numerical analysis, optimization, probability, set theory, statistics, topology, and trigonometry are some of the major fields of Mathematics. According to the study conducted in Mindoro, Philippines, Statistics and Probability is a branch of Mathematics with a wide range of applications and problem-solving scenarios that necessitate critical thinking and problem-solving abilities. It is incorporated into the elementary and junior high school curricula and core topics in senior high school, using a spiral progression strategy (Candelario-Aplaon, 2017).

However, the Philippines scored 297 in Mathematics and 249 in science in the 2019 Trends in International Mathematics and Science Study (TIMMS), according to inquirer.net (Aurelio, 2020). In comparison to other participating countries, they were "much lower." In the TIMMS, which measured Mathematics and science proficiency among Grade 4 pupils, Filipino children came in last out of 58 countries. The findings show that students in the Philippines score poorly in Mathematics compared to other countries. Some students believe that Mathematics is a boring subject, that it is difficult to learn, and that some topics in Mathematics are not important in life.

Students must learn several different fields of Mathematics. Statistics and Probability are two of them. Weather forecasting, life expectancy, sports, games, and recreational activities, risk assessment in business and game theory, environmental regulation, product reliability, defense strategies, medical decisions, scenario analysis, and population estimates are just some of the applications of the subject (Candelario-Aplaon, 2017). In addition, Probability is one of the most important ideas in mathematical learning since it is one of the most important principles in Mathematics. Furthermore, probability and statistics theory can be applied to the physical world, which will, of course, need students to apply their knowledge, gather, record, understand, analyze, convey, and present the information they need to make decisions (Anggara et al., 2018).

Due to the importance of Probability and statistics to our daily life, the researcher should be motivated to do the study to evaluate the needs of senior high school Mathematics instructors in terms of teaching statistics and Probability, as this will serve as the foundation for providing the necessary training (Candelario-Aplaon, 2017). According to a study conducted in the Philippines, school public administrators should improve K-12 school facilities, and teachers should collaborate to improve students' self-efficacy, attitudes toward statistics, and teaching statistics. Administrators may also create opportunities for Statistics teachers to polish their pedagogical abilities in fostering and building students' self-confidence and interest in the subject (Retutas & Rubio, 2021).

When it comes to Probability and Statistics, there are numerous subjects to examine. According to the central limit theorem, the normal distribution is one of the most important topics to be considered since almost all real-life situations are normally distributed. Despite its importance in statistics, many first-year statistics students struggle to grasp the normal distribution because of its complexity and lack of basic math skills. Students are perplexed by the size and sequence of negative numbers when dealing with situations involving normally distributed random variables; z-scores on a typical normal curve are used (Delport, 2022). In addition, the study "How the Number Line Can Be Used to Promote Students'

Understanding of the Normal Distribution" shows that teachers should employ an effective teaching tool to increase students' conceptual knowledge of the normal distribution (Delport, 2022).

MATERIAL, METHODOLOGY, AND LITERATURE REVIEW

Material of the Study

This study used the quasi-experimental research design to determine the effectiveness of using conventional whiteboard in teaching Probability and Statistics online. The participants of the study were 40 students from the two sections in HUMSS 11 in Senior High School. Out of the 40 students, 20 students from Humanities and Social Sciences (HUMSS) 11-A composed the experimental group, and 20 students from Humanities and Social Sciences (HUMSS) 11-B for the control group. They were chosen through purposive sampling technique. The composition of students for the two groups was based on pairing their Mathematics grades during the first semester of the school year 2021-2022. In addition, the students involved were those who gave their consent to participate in the study.

In addition, the following are the research tools that were employed in the study. Firstly, a test on Normal Distribution. It was used to determine the students' performance in Probability and statistics. The test was a 120-item test, and it was divided into three (3) specific tests. The first test was a 40-item test on constructing normal distribution. The second test was a 40-item test on the area under the normal curve, and the last was a 40-item test on solving problems involving normal distribution. The researcher also gave the students a learning module and a PowerPoint presentation about the topic before the discussion. Secondly, Learning Modules on Constructing Normal Distribution. There were used in presenting the overview of the topics and outcomes involved in the study. The general concept was on Normal distribution, divided into three specific learning outcomes. The first learning outcome was on demonstrating familiarization with the basic concept of normal distribution, normal curve, and constructing normal curve. The second learning outcome was finding the common area of a normal curve, the cumulative table for normal distribution, and the area under the normal curve. Lastly, the third learning module was on solving problems involving standard normal distribution.

Moreover, the statistical package for social sciences (SPSS) software was utilized in the study to analyze the data using the mean and standard deviation tools. This was used to determine the pretest and posttest results for the control and experimental groups. Then, the T-test was used to ascertain whether there was a significant difference between the control group's pretest and posttest results, the experimental group's pretest and posttest results, and the significant difference between the control groups and the experimental group's posttest results.

Methodology

The researcher asked for approval from the Dean of the Graduate School and Principal of the Basic Education Department before experimenting. When permitted to conduct the study, The researcher made certain that the research volunteers were not in any way harmed. The research participants' dignity was of the utmost significance. Respondents were required to get a written agreement to participate in the study. The privacy of the research respondents, the security of the research data, and the names of those who participated in the study were all protected. Any communication relating to the research was done openly and honestly. Any potentially deceptive content, as well as any skewed representation of major data

results, were avoided. The authors observed ethical issues (including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and submission, redundancy, etc.).

The researcher then prepared and distributed the learning materials (modules and PowerPoint presentation slides) to the experimental and control groups. In gathering the data, two sections from HUMSS 11 in the Basic Education Department of Misamis University were utilized as respondents of the study. HUMSS 11-A was the experimental group, and HUMSS 11-B was the control group. The researcher used three subtopics about Normal Distribution, and each was used in the discussion once a week for three weeks. The researcher conducted three sessions to gather the data. In every session, both groups took the same 40-item test that determined their pretest performance. After the pretest, the experimental group received an online/synchronous discussion about a subtopic in distribution using a conventional whiteboard.

It means the teacher discussed the lesson using a conventional whiteboard like the one the teacher did during face-to-face discussion. Online/synchronous discussion was also given to the control group in every session but through PowerPoint presentation only. After conducting a synchronous discussion in every session, both groups took a 40-item posttest to identify their performance. After the last session and checking all tests, the researcher attained the mean scores of the pretest and posttest scores in every session then the scores were tallied and interpreted.

Literature Review

A study conducted in China on the design and evaluation of cross-object user interface for whiteboard interaction says that teachers have been utilizing whiteboards for a long time as one of the most significant instruments for teaching and communication, and it was found that it was very effective (Liljedahl, 2016).). Students in the traditional whiteboard condition were found to be more engaged, and students in the traditional whiteboard condition paid greater attention to the learning information on the board (Mayer & Estrella, 2014).). Observing the instructor's technique for using a classic or conventional whiteboard greatly enhances the learning experience for learners. Students can observe and imitate human gestures with the mirror neuron system, which creates a sense of closeness and improves cognitive engagement (Rahnert, 2021). As a result, it increases student engagement by allowing them to communicate with the lecturers. It also aids the teacher inappropriately illustrating the content by letting them freely draw diagrams, tables, graphs, and pictures, allowing pupils to visualize the information and easily mimic what the teacher is doing.

In the last part of 2019, the use of the traditional whiteboard in the discussion was misplaced. The Covid-19 pandemic, which began in Wuhan, China, has spread rapidly from place to place and from one person to another and has shocked the entire world. Face-to-face learning has been restricted due to the outbreak of Covid-19 and the Movement Control Order for social distancing (Chung et al., 2020). Online learning has become one of the most often used methods in the teaching and learning process (Subramanya, 2021). The pandemic has had a direct impact on universities all across the world. Online learning thus takes the place of traditional face-to-face learning (Chung et al., 2020).

A study conducted in Indonesia found that online learning is very helpful during a pandemic (Allo, 2020). According to Howlett, online learning uses electronic technology and media to offer, support,

and enhance learning and teaching. It entails communication between students and teachers via online information. Students did well in class during online learning, and students and their parents will become involved in at-home learning. (Dianito et al., 2021). According to (Mukhtar et al., 2020), "online learning modalities encourage student-centered learning, and they are easily manageable during this lockdown situation." Academically, while students can essentially study anything online, learning may be less than optimal, particularly in classes that require face-to-face contact and direct interactions (Franchi, 2020).

However, the online learning-enabled distant study was manageable and provided students with easy access to teachers and instructional materials. It also cut down on the usage of travel resources and other costs. In addition, it simplified administrative responsibilities like recording lectures and keeping track of attendance. During the lockdown, students and teachers agreed that online learning modes facilitated student-centeredness. The students had evolved into self-directed learners who could learn anytime during the day (Mukhtar et al., 2020). There are several questions that people have about online learning. Some of them asked about the types of Online Learning methods adopted by students in the past and the challenges they faced while learning online (Chung et al., 2020). Some institutions/universities employ an online learning platform such as Microsoft Teams or Google Classroom for pure online learning, while others use a mixed-methods approach or blended learning (Chung et al.,2020). Students prefer pre-recorded lectures posted to Google Classroom and YouTube for online learning, while internet connectivity is challenging (Chung et al., 2020). But problems such as lack of face-to-face engagement with the instructor, long response times, and a lack of traditional classroom socialization were considered (Adnan & Anwar, 2020).

In the Philippines, among the obstacles discovered are learning difficulties of senior high school students based on probability understanding levels", organizing sample space, events, and mathematical models related to probability problems. Furthermore, students struggled to grasp the concepts of events and the concept of prerequisites (Anggara et al., 2018). Word questions are frequently used to present probabilities of events occurring. Students have difficulty converting these statements into the proper probability notation, which frequently comprises letters and inequality symbols. As a result, when students are asked to calculate the chance of an event occurring, they shade the erroneous areas on the bell-shaped curve (Delport, 2022).

One of the tools used to address some issues about online learning is the so-called Interactive whiteboards. It is one of the most popular and essential tools for teaching and learning, creating a high degree of student motivation, teachers' enthusiasm, and whole-school support (Atencio et al., 2021). The interactive whiteboard is a program or software that serves as the virtual whiteboard in which the teacher can write and draw. According to a study conducted in China, interactive whiteboard technology can assist students in learning to write (Teng, 2021). In addition, learners who received collaborative writing instruction using an interactive whiteboard had higher levels of metacognitive activities and were more involved in coregulation. It also improves the performance of higher secondary students in English vocabulary classes (Rizwan et al., 2018).

Many studies have shown that interactive whiteboards (IWBs) can increase the quality of teaching and learning by increasing engagement, communication, and cooperation. However, even today, these IWBs have certain drawbacks, in that they are not appropriate for freehand drawing because they require greater precision than typical input devices such as the mouse. Unlike software, freehand drawings are incredibly satisfying (Mwandosya, 2021). Many students believed that the presentation with hands helped their learning the most since it was easy to follow and taught them how to execute similar exercises independently (Rahnert, 2021). Because of the teachers' and students' poor and unpredictable internet connections, virtual interactive whiteboards create a problem because the response of the gadget varies depending on the bandwidth and type of gadget used. The greatest difficulty with Interactive Whiteboard platforms or applications is that they require a high-speed internet connection and a capable device.

There are a lot of studies that prove the effectiveness of interactive whiteboard discussion using software online. Still, few studies were conducted to find the significance of using a conventional whiteboard in teaching Mathematics online, particularly in constructing the normal curve graph, finding the area under a normal curve, and solving problems involving normal distribution in Probability and statistics. Thus, the researchers wanted to address this gap with the intention that the finding might bring educational benefits.

At Misamis University, one of the main challenges in instruction is the sudden change from face-to-face to online learning. The difficulties raised included the lack of face-to-face interaction between the instructor and students during teaching, response time, and the absence of traditional classroom socializing. In online learning, common teaching strategies include a PowerPoint presentation and a recorded discussion. In a pre-recorded discussion, interaction is less, and response is not on time. In a PowerPoint presentation, a student is provided a static picture of the overall information allowing students to construct their picture of the idea. In Mathematics, pictures are vital for comprehension. Still, live discussion with the teacher discussing using a conventional whiteboard/blackboard is even more significant since it allows students to interact with teachers, observe, follow what they are doing, and even copy the process and the technique in solving graphing and sketching. This study may help the teacher become more productive and effective in teaching Mathematics. In addition, it may also allow the students to become more motivated to join every class. Finally, it may cause them to actively participate in the discussion resulting in better learning and performance.

RESULTS AND DISCUSSION
Pretest Performances of the Control Group and Experimental Group

Table 1 shows the pretest performance of the control and experimental groups on Probability and Statistics, particularly in Normal Distribution. It shows that the pretest performance of the control group is very poor (M = 7.78; SD = 1.82) while the pretest performance of the experimental group is poor (M = 11.08; SD = 3.75). Hence, the experimental and control groups performed below the expected acceptable performance level to pass the test. This further implies that when the test was conducted before the topic discussion, the students had a poor grasp of learning and understanding the Mathematics concepts.

The results revealed that students were unlikely to comprehend the Math concepts without a lecture or discussion with the appropriate instructional materials, resulting in an incorrect answer to the test. Although the students in the experimental group scored a little higher than those in the control group, both performances failed to reach the so-called "good" performance, implying it is not at a satisfactory level. A lack of understanding of the basic math skills on normal distribution could be another reason, knowing that this concept was already taught in junior high school as part of the Mathematics curriculum. In addition, students found it challenging to understand the problem and identify the possible mathematical solutions leading to the correct answer.

The study about Simplified Instructional Materials supports the findings mentioned above. It states that instructional material had a favorable impact on learners, leading to increased student academic performance. Instructional materials allow students to better understand a problem and expose them to various approaches and solutions that may be used in more complex mathematical problems and in everyday life. (Ares, 2022). In addition, many statistics students struggled to grasp the concept of normal distribution because of its complexity and lack of basic math skills (Delport, 2022).

Moreover, organizing sample space, events, and mathematical models related to probability problems are among the obstacles discovered by the students (Anggara et al., 2018). These studies provide strong evidence that the lack of instructional materials and prior knowledge are hindrances in learning complex applications of concepts on Probability and statistics. When students fail to equip themselves with basic mathematical skills from their previous grade-level experience, they are most likely to encounter a similar learning difficulty in their current status.

The data imply that lacking instructional support from the teacher may lead to the poor performance of students on Probability and statistics. In this study, the students did not satisfactorily perform because they could not relate to and apply their prior knowledge to the mathematical problems involving the same topic but of a more complex application level. Hence, Junior High School teachers play a crucial role in teaching these concepts as they need to cover and focus on teaching the basic math skills, mathematical models, and probability problems so that they may help the students acquire the prerequisite knowledge needed for the Senior High school. Furthermore, problems involving real-life situations are also important to let the students realize its use that may contribute to their retention.

Table 1 Pretest Performance of the Control Group and Experimental Group

Groups	Mean Scores	SD	Remarks
Control Group	7.78	1.82	Very Poor
Experimental Group	11.08	3.75	Poor

Note. Performance scale: 33-40 (Very Good); 25-32 (Good); 17-24 (Fair); 9-16 (Poor); 1-8 (Very Poor)

Posttest Performance of the Control Group and Experimental Group

Table 2 shows the posttest performance of the control and experimental groups in Probability and Statistics tests, particularly in Normal Distribution. It reveals that the posttest performance of the control group is fair (M = 19.67; SD = 7.20) while the posttest performance of the experimental group is very good (M =

35.20; SD = 2.47). This shows that the experimental group scored higher in the posttest than the control group. The experimental group was taught with normal distribution using the conventional whiteboard. On the other hand, a PowerPoint presentation was used to teach the same topic to the control group.

The findings indicate that after using two types of instructional materials in teaching normal distribution to students, the two groups of participants have shown increased but different levels of performance in the posttest. The higher performance of the experimental group than the control group demonstrates the stronger impact of the conventional whiteboard on learning probability and statistics. However, it cannot be discounted that those students had improved their performance in the pretest and posttest even with the teacher's PowerPoint presentation as an instructional aid. But in this case, students in the experimental group had a better performance in the posttest than those in the control group. Specifically, the experimental group outperformed the control group by 15 points in terms of their mean scores.

The control group's mean score rose from 7.78 in the pretest (table 1) to 19.67 in the posttest (Table 2), while the experimental group's mean score rose from 11.08 (table 1) in the pretest to 35.20 in the posttest (Table 1). These results revealed that the students' performance undoubtedly improved after a discussion using PowerPoint Presentation for the control group and Conventional Whiteboard for the experimental group. In comparison, using conventional whiteboards has led to higher test scores than simply a PowerPoint presentation.

The findings on the positive effect on performance in using a conventional whiteboard to learn Mathematics has been proven in the study on remote accounting education, which indicated that the use of classic and conventional whiteboard greatly enhances the learning experience of the students (Rahnert, 2021). Notwithstanding, PowerPoint presentations were also made to improve learning by allowing viewers to see more organized and engaging presentations (Adonu, 2021). In addition, the study about Random Sampling proficiency of grade 11- STEM students in Mindanao states that simplified Instructional Materials in Basic Math were a potent tool for bridging the gap in correcting random sample shortcomings such as various sampling strategies. Instructional material had a favorable impact on learners, leading to increased student academic performance (Ares, 2022).

The data imply that using a conventional whiteboard will greatly enhance students' learning of Probability and statistics in teaching online. This tool has been widely used by Mathematics teachers teaching the students inside the physical classroom. Using a tool such as the conventional whiteboard can improve students' engagement, retention, and understanding, eventually increasing students' performance. In addition, the teacher's familiarity and expertise in problem-solving exercises through the conventional whiteboard make it easier for students to understand and appreciate Mathematics as a core subject.

Table 2 Posttest Performance of the Control Group and Experimental Group

Groups	Mean Scores	SD	Remarks
Control Group	19.67	7.20	Fair
Experimental Group	35.20	2.47	Very Good

Note. Performance scale: 33-40 (Very Good); 25-32 (Good); 17-24 (Fair); 9-16 (Poor); 1-8 (Very Poor)

Difference Between the Pretest and Posttest Performances of the Control Group

A paired t-test was run on a sample of 20 HUMSS11-B students (control group) to determine whether there was a statistically significant mean difference between their pretest and posttest scores. As presented in Table 3 shows that the computed p-value (<0.01) is less than the 0.05 level of significance. Hence, the null hypothesis was rejected. There was a highly significant difference between the control group's pretest (M=7.78, SD=1.82) and posttest (M=19.67, SD=7.20) performance in Probability and statistics, specifically on normal distribution; $t(19) = -6.626$, $p=<0.01$. Results show that the student's performance in the posttest is statistically and significantly higher than their performance in the pretest. It means that the student's test performance had significantly increased with PowerPoint presentations in discussing the topic.

Based on the findings, using PowerPoint presentations as instructional material in teaching normal distribution online has allowed students to learn and understand the concept. In addition, it helped aid the students in organizing information for comprehension. It also assisted them in familiarizing themselves with problem-solving terms and the processes and steps involved in plotting and graphing. Furthermore, compared to a simple talk, a PowerPoint Presentation is more solid and active as it allows the students to read, familiarize themselves, and see organized and visible information about the topic.

The findings indicated in the table are supported by a study conducted in Nigeria on improving students' achievement and retention in biology using flipped classrooms and PowerPoint instructional approaches. The study revealed that PowerPoint presentations were created to help students learn by allowing viewers to see better organized and engaging presentations (Adonu, 2021). Utilizing the PowerPoint presentation in teaching can expand enthusiasm for learning, just as the simple ingestion of the material with the goal that it can improve student learning results in teaching Mathematics (Suson & Ermac, 2020). Further, utilizing PowerPoint to address students' needs, just as the educator's needs, by moving from a passive, teacher-focused (accordingly lecture style) classroom to an interactive, student-centered classroom is highly fundamental (Inoue-Smith, 2016).

A PowerPoint presentation is a good instructional tool in teaching probability and statistics, including online teaching mode of delivery, since it will give the students a visible picture of the overall idea of the topic taught. Furthermore, it implies that the teacher may use PowerPoint presentations in their discussion in Mathematics, especially in Probability and statistics. With their enhanced skills in making a good lesson presentation through watching tutorials on YouTube and attending seminars about the use of technology like PowerPoint Presentation, they can potentially make learning possible for their students.

Table 3 Difference between the Pretest and Posttest Performances of the Control Group

Performance	Mean Score	SD	t value	p value	Interpretation
Pretest	7.78	1.82			
Posttest	19.67	7.20	-6.626	<0.01	Highly Significant

*Note: Probability Value Scale: **p<0.01 (Highly Significant); *p<0.05 (Significant); p>0.05 (Not significant)*

Difference Between the Pretest and Posttest Performances of the Experimental Group

A paired t-test was used to determine whether there was a statistically significant difference between the pretest and posttest performances of 20 HUMSS 11-A students (experimental group). As Table 4 revealed, the computed p-value (<0.01) is less than the 0.05 level of significance. Hence, the null hypothesis was rejected. There was a highly significant difference in the pretest (M=11.80, SD=2.47) and posttest (M=35.20, SD=3.75) performances of the students in the experimental group; t=-28.187, p=<0.01. The students' posttest performance is significantly higher than their pretest performance.

Findings revealed that using a conventional whiteboard to discuss normal distribution, a concept in Probability and statistics, effectively improved the students' test performance. Students benefited from the discussion by making them easily grasp the mathematical problems when presented by the teacher using the conventional whiteboard. Furthermore, students could follow the presentation as the teacher on the whiteboard illustrated it.

In addition, the findings show that students' performance improved significantly after discussing the Normal distribution online using a traditional whiteboard. The traditional whiteboard discussion allowed the students to participate in the discussion. It encouraged them to participate in the lecture with question-and-answer exercises. It also assisted them in eliciting more thoughts and increasing their confidence in the discussion. Likewise, the conventional whiteboard discussion approach enabled students to observe and follow and replicate the process.

This finding is supported by the study about the impact of whiteboards on learning which cited that the use of whiteboards helps the students engage more in problem-solving, elicit ideas, provide opportunities to increase their motivation, and promote confidence in the class (Irani et al., 2020). The act of "doing" Mathematics on whiteboards thus lets students adopt similar practices to mathematicians, that is, actively explore, annotate, erase and redraw mathematical concepts in an easily visible format. These also indicate high levels of engagement, active learning, and peer learning, as well as offering opportunities for student feedback (Liljedahl, 2016) because Mathematics becomes a shared and visible representation of students' mathematical thinking that is critical for the development of reasoning (Sanders et al., 2019).

The findings imply that using a conventional whiteboard is important as an instructional tool for learning Probability and statistics. This will help simplify the concepts and aid students in following through with the discussion with the teacher. Students can learn productively online when the teacher can maximize learning resources in teaching Mathematics, including using the conventional whiteboard. That is why the teacher can keep practicing how effectively illustrate math concepts using a conventional whiteboard during their online classes. In addition, the teachers may practice it before the online discussion to adjust to the time and the approach in the discussion.

Table 4 Difference between the Pretest and Posttest Performances of the Experimental Group

Performance	Mean Score	SD	t value	p value	Interpretation

*Note: Probability Value Scale: **p<0.01 (Highly Significant); *p<0.05 (Significant); p>0.05 (Not significant)*

Difference Between the Posttest Performances of the Control Group and Experimental Group

An independent samples t-test was used to test whether there was a statistically significant difference in the posttest performances between the control and experimental groups. The computed p-value (<0.01) is less than the 0.05 level of significance; thus, the null hypothesis was rejected. There was a highly significant difference between the posttest performances between the control group (M=19.67, SD=7.20) and the experimental group (M=35.20, SD=2.47); t (19)=-9.127, p=<0.01. As presented in Table 5, the experimental group had a higher posttest performance than the control group.

The findings show that using a conventional whiteboard to teach normal distribution in Probability and statistics led to a more significant increase in students' performance than with the PowerPoint presentation. Although both instructional aides had improved the students' performance in the posttest, the posttest mean score of the experimental group was 15 points higher than the mean score gained by the control group, which implies the effect of the conventional whiteboard on the performance was significantly high. Conventional whiteboards can better facilitate students' learning in Probability and Statistics than simply with PowerPoint presentation slides.

Further, the data show that utilizing a traditional whiteboard discussion allows the students to participate actively in the online activities. These whiteboards will create a very interactive environment, making the class livelier. It will also increase their motivation to participate in the discussion. Furthermore, it can assist students in focusing on the teaching-learning process and learning materials. Finally, it allows students to comprehend and observe the process and follow and imitate it.

The findings are linked to the observational learning theory used as a framework in this study which states that the learning and acquisition of attitudes, values, and styles of thinking and behaving are through observation. Students can imitate and follow the process through observation. By watching the discussion, like through a conventional whiteboard, the students can observe the teacher's gestures, allowing them to analyze the process and learn every detail in the discussion. In addition, the sociocultural and engagement theories also support the findings since the learners can actively participate in the discussion as they interact with the teacher. As a result, they are motivated to participate and engage in the learning process.

The data revealed are supported by the study about teaching in remote accounting education. The results indicated that using classic and conventional whiteboards greatly enhances the students' learning experience. In addition, many students also believed that the presentation with hands helped their learning the most since it was easy to follow and taught them how to execute similar exercises independently (Rahnert, 2021). Moreover, the study about learning Media in Training analysis stated that this whiteboard's benefits include creating an interactive environment, the class being more dynamic, the interaction between the trainer and the participants, and the participants being able to focus on the learning material. (Lestyowati & Rahmi, 2022). Thus, it is suggested that the teacher may use a conventional whiteboard in their discussion on Probability and statistics, especially on the topic of normal distribution.

The data imply that using a conventional whiteboard is much more effective than a PowerPoint presentation; thus, the teacher may use it to discuss Probability and statistics online. The conventional whiteboard can provide students with organized information about the subject matter. It will also guild the

students about the process since they can see the teacher doing it. It can also motivate the students to participate because they will feel like they are in a real classroom with the teacher and other students. For the teachers to use it effectively, they may practice a discussion using a conventional whiteboard. In addition, the teacher can also watch videos on the internet about using a conventional whiteboard in online discussions. Lastly, the teachers can also seek additional input using this instructional material in teaching Mathematics online.

Table 5 Difference in the Posttest Performances between the Control Group and Experimental Group

Groups	Mean Score	SD	t value	p value	Interpretation
Control Group	19.67	7.20	-9.127		
Experimental Group	35.20	2.47		<0.01	Highly Significant

*Note: Probability Value Scale: **p<0.01 (Highly Significant); *p<0.05 (Significant); p>0.05 (Not significant)*

Conclusions

The findings of the study have led to several of significant conclusions. Firstly, without any discussion about the Probability and statistics, students in experimental and control groups had low performance in the pretest. Secondly, students exposed to the discussion using the conventional whiteboard performed higher in the posttest on Probability and statistics than those exposed to the discussion with a PowerPoint presentation. Thirdly, using PowerPoint Presentation in teaching Probability and statistics online effectively improves students' performance. Fourthly, using a conventional whiteboard in teaching Probability and statistics online effectively improves students' performance. Lastly, a conventional whiteboard is more effective than PowerPoint presentations in teaching Probability and statistics online.

REFERENCES

1. Adnan, M., & Anwar, K. (2020). Online Learning amid the COVID-19 Pandemic: Students' Perspectives. Online Submission, 2(1), 45-51. Retrieved on December 15, 2021 from https://bit.ly/3vzdcCj

2. Alazemi, A. R., & Yew, W. T. (2022). Effect of the interactive whiteboard on Mathematics word problems: evidence from Kuwait. International Journal of Innovation and Learning, 31(1), 117-136. Retrieved on December 15, 2021 from https://bit.ly/3vD7wHJ

3. Allo, M. D. G. (2020). Is the online learning good in the midst of Covid-19 Pandemic? The case of EFL learners. Jurnal Sinestesia, 10(1), 1-10. Retrieved on December 15, 2021 from https://bit.ly/3HFY7S1

4. Anggara, B., Priatna, N., & Juandi, D. (2018, May). Learning difficulties of senior high school students based on probability understanding levels. In Journal of Physics: Conference Series (Vol. 1013, No. 1, p. 012116). IOP Publishing. Retrieved on March 15, 2022 from https://bit.ly/364ceDJ

5. Ares, E. J. (2022). Sim (Simplified Instructional Materials): Towards Random Sampling Proficiency of Grade 11-Stem 1 Students in University of Mindanao Digos College. Available at SSRN 4093851. Retrieved on June 27, 2022 from https://bit.ly/3nsZxaI

6. Atencio, Y. P., Ibarra, M. J., Marín, J. H., Condori, R. F., Yanqui, F. T., & Cerrón, J. O. (2021, October). Calligraphic Drawing for Collaborative Virtual Whiteboard Systems. In International Conference on Cooperative Design, Visualization and Engineering (pp. 232-239). Springer, Cham. Retrieved on December 15, 2021 from https://bit.ly/3trF6xA

7. Aurelio, J. (2020). DepEd blamed for poor PH ranking in math, science. Philippine Daily Inquirer. Retrieved on June 6, 2022 from https://bit.ly/3x7UUrb

8. Bandura, A. (2008). Observational learning. The international encyclopedia of communication. Retrieved on December 15, 2021 from https://bit.ly/3tuK9gD

9. Bandura, A. (1986). Social foundations of thought and action. Englewood Cliffs, NJ, 1986(23-28). Retrieved on March , 2022 from https://bit.ly/3OjHwqY

10. Britannica, T. Editors of Encyclopaedia (2021, September 22). Mathematics summary. Encyclopedia Britannica. Retrieved on March 14, 2022 from https://bit.ly/3IisE8K

11. Candelario-Aplaon, Z. (2017, December). Needs assessment of senior high school Mathematics teachers in teaching Statistics and Probability. In International Forum Journal (Vol. 20, No. 2, pp. 143-159). Retrieved on March 17, 2022 from https://bit.ly/3IgcRHq

12. Chung, E., Noor, N. M., & Mathew, V. N. (2020). Are you ready? An assessment of online learning readiness among university students. International Journal of Academic Research in Progressive Education and Development, 9(1), 301-317. Retrieved on December 15, 2021 from https://bit.ly/35nVV4D

13. Chung, E., Subramaniam, G., & Dass, L. C. (2020). Online learning readiness among university students in Malaysia amidst COVID-19. Asian Journal of University Education, 16(2), 46-58. Retrieved on December 15, 2021 from https://bit.ly/3tvLe83

14. Cook, T. D., Campbell, D. T., & Day, A. (1979). Quasi-experimentation: Design & analysis issues for field settings (Vol. 351). Boston: Houghton Mifflin. Retrieved on December 15, 2021 from https://bit.ly/3DiUuRg

15. Croft, T., Grove, M., & Lawson, D. (2022). The importance of Mathematics and statistics support in English universities: an analysis of institutionally-written regulatory documents. Journal of Higher Education Policy and Management, 1-18. Retrieved on March 17, 2022 from https://bit.ly/3IcJaqW

16. Delport, D. H. (2022). How the Number Line Can Be Used to Promote Students' Understanding of the Normal Distribution. Numeracy, 15(2), Retrieved on March 17, 2022 from https://bit.ly/3Inmd4e

17. Dianito, A. J., Espinosa, J., Duran, J., & Tus, J. (2021). A glimpse into the lived experiences and challenges faced of PWD students towards online learning in the Philippines amidst COVID-19 pandemic. International Journal Of Advance Research And Innovative Ideas In Education, 7(1), 1206-1230. Retrieved on December 15, 2021 from https://bit.ly/3IIvaGo

18. Franchi, T. (2020). The impact of the Covid-19 pandemic on current anatomy education and future careers: A student's perspective. Anatomical Sciences Education, 13(3), 312. Retrieved on March 17, 2021 from https://bit.ly/35mkajH

19. Garfield, J., & Ahlgren, A. (1988). Difficulties in learning basic concepts in probability and statistics: Implications for research. Journal for research in Mathematics Education, 19(1), 44-63. Retrieved on March 17, 2022 from https://bit.ly/3wpbvrx

20. Irani, F. H., Afshar, N. R., Hosaini, D., Shahri, H., Parvizi, M., Kamali, P., & Barati, Z. (2020). The Impact of Blackboards or Whiteboard on Language Learning. The English Teacher, 49(1), 17-25. Retrieved on March 17, 2022 from https://bit.ly/3NlqitA

21. Johnson, B., & Christensen, L. (2000). Educational research: Quantitative and qualitative approaches. Allyn & Bacon. Retrieved on March 10, 2022 from https://bit.ly/3iLrWGM

22. Kapur, R. (2018). Factors influencing the students academic performance in secondary schools in India. University Of Delhi. Retrieved on March 17, 2022 from https://bit.ly/3qoZAq4

23. Kasmin, F., Othman, Z., & Ahmad, S. S. S. (2019). Improving students' perception towards learning Mathematics: Impact of teaching application of Mathematics. EDUCATUM Journal of Science, Mathematics and Technology, 6(1), 29-34. Retrieved on March 8, 2022 from https://bit.ly/3i7oS7l

24. Kearsley, G., & Schneiderman, B. (1999). Engagement theory: A framework for technology-based learning and teaching. Educational Technology, 38(5), 20-23.

25. King, S. A., Lemons, C. J., & Davidson, K. A. (2016). Math interventions for students with autism spectrum disorder: A best-evidence synthesis. Exceptional Children, 82(4), 443-462. Retrieved on March 17, 2022 from https://bit.ly/3u1SkRP

26. Lestyowati, J., & Rahmi, I. (2022, January). Analysis of Learning Media in Training. In 5th International Conference on Current Issues in Education (ICCIE 2021) (pp. 74-79). Atlantis Press. Retrieved on June 6, 2022 from https://bit.ly/3thSPrw

27. Liljedahl, P. (2016). Building thinking classrooms: Conditions for problem-solving. In Posing and solving mathematical problems (pp. 361-386). Springer, Cham. Retrieved on June 6, 2022 from https://bit.ly/3xoxbCYhttps://bit.ly/3thSPrw

28. Mayer, R. E., & Estrella, G. (2014). Benefits of emotional design in multimedia instruction. Learning and Instruction, 33, 12-18. Retrieved on December 15, 2021 from https://bit.ly/35p1i3w

29. Mukhtar, K., Javed, K., Arooj, M., & Sethi, A. (2020). Advantages, Limitations and Recommendations for online learning during COVID-19 pandemic era. Pakistan journal of medical sciences, 36(COVID19-S4), S27. Retrieved on December 15, 2021 from https://bit.ly/3vGTHb5fra

30. Mwandosya, G. I. (2021). Mobile technology for innovative teaching and learning in Tanzanian higher education (Doctoral dissertation, Itä-Suomen yliopisto). Retrieved on December 15, 2021 from https://bit.ly/3hEGMOS

31. Parviainen, P. (2019). The development of early mathematical skills: A theoretical framework for a holistic model. Journal of Early Childhood Education Research, 8(1). Retrieved on March 16, 2022 from https://bit.ly/3weaEd7

32. Rahnert, K. (2021). The teaching hand in remote accounting education: bringing mirror neurons into the debate. Accounting Education, 1-20. Retrieved on December 15, 2021 from https://bit.ly/3KeN97z

33. Retutas, M. J., & Rubio, M. T. (2021). Multivariate Analysis on Performance in Statistics, Self-Efficacy and Attitudes of Senior High School Students. Journal of Research and Advances in Mathematics Education, 6(4), 352-367. Retrieved on March 17, 2022 from https://bit.ly/3u2WY23

34. Reynolds, A. R., & Walberg, H. J. (1992). A process model of Mathematics achievement and attitude. Journal of Research in Mathematics, 23(4), 306-328. Retrieved on March 14, 2022 from https://bit.ly/3uoz958

35. Rizwan, M., Ayub, S., & Khan, S. (2018). Effect of Interactive Whiteboard on Academic Achievement of Higher Secondary School Students. Pakistan Journal of Distance and Online Learning, 4(2), 213-224. Retrieved on December 15, 2021 from https://bit.ly/3sDRCuv

36. Sanders, S., Nielsen, W. S., McPhail, C., & Forrester, P. A. (2019). Maths anxious pre-service teachers' perspectives of" doing" Mathematics in a whiteboard room. Retrieved on June 6, 2022 from https://bit.ly/3b2UMBY

37. Inoue-Smith, Y. (2016). College-based case studies in using PowerPoint effectively. Cogent education, 3(1), 1127745. Retrieved on June 6, 2022 from https://bit.ly/3Hu3GV3

38. Stovner, R. B., & Klette, K. (2022). Teacher feedback on procedural skills, conceptual understanding, and mathematical practices: A video study in lower secondary Mathematics classrooms. Teaching and Teacher Education, 110, 103593. Retrieved on March 17, 2022 from https://bit.ly/3IbYGmD

39. Subramanya, S. (2021). Techniques for effective teaching and learning in the wake of transition to online classes due to COVID-19: conference tutorial. Journal of Computing Sciences in Colleges, 36(7), 86-87. Retrieved on December 15, 2021 from https://bit.ly/35J0beG

40. Suson, R., & Ermac, E. (2020). Computer aided instruction to teach concepts in education. International Journal on Emerging Technologies, 11(3), 47-52. Retrieved on June 6, 2022 from https://bit.ly/3xvDZPn

41. Teng, M. F. (2021). Interactive-whiteboard-technology-supported collaborative writing: Writing achievement, metacognitive activities, and co-regulation patterns. System, 97, 102426. Retrieved on December 15, 2021 from https://bit.ly/3HGmxus

42. Tomasello, M., Kruger, A. C., & Ratner, H. H. (1993). Cultural learning. Behavioral and brain sciences, 16(3), 495-511. Retrieved on March 18, 2022 from https://bit.ly/3JJtRY0

43. Vostanis, A., Padden, C., Chiesa, M., Rizos, K., & Langdon, P. E. (2021). A precision teaching framework for improving mathematical skills of students with intellectual and developmental disabilities. Journal of Behavioral Education, 30(4), Retrieved on March 17, 2022 from 513-533. https://bit.ly/3udLV6e

44. Yoon, H., Scopelliti, I., & Morewedge, C. K. (2021). Decision making can be improved through observational learning. Organizational behavior and human decision processes, 162, 155-188. Retrieved on June 12, 2022 from https://bit.ly/3O7Wj7Z