COMPUTER-based Instruction and Mathematics Achievement of Senior High Students in Statistics and PROBABILITY

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ABSTRACT

This study aimed to determine the effectiveness of computer-based instruction through Microsoft Excel on the mathematics achievement of senior high school students in the selected topics in statistics and probability. Employing the quasi-experimental design, the researcher conducted the pre-test and post-test on purposively selected Grade 11 students in one of the private schools in Cabantian, Davao City, using the 35-item validated questionnaire. The control group utilized the prevailing method, and the experimental group utilized the computer-based instruction through MS Excel. The mean, standard deviation, independent and dependent samples t-tests and effect size were used to analyze and interpret the data. The pre-test results showed that both the control and experimental group had the same level of achievement, the control group had fairly satisfactory achievement, while the experimental group did not meet expectations. However, the post-test results showed that there was a significant difference in the achievement of students when taught using the prevailing method, but they performed better using the computer-based instruction. This study concluded that computer-based instruction through MS Excel successfully increased students' achievement in selected topics in statistics and probability.

KEYWORDS: *Education, mathematics, computer-based instruction, quasi-experimental, statistics and probability, achievement, Philippines*

INTRODUCTION

Mathematics achievement refers to the demonstrated proficiency of students in the field of mathematics (Pandey, 2017). Moreover, mathematics achievement is important for developing critical thinking and problem-solving

skills, which are essential for both academic and real-life application, according to the National Council of Teachers of Mathematics (NCTM, 2021). Within the K to 12 curriculum of the Philippines, statistics and probability is introduced in elementary school, spanning from Grade 1 to Grade 6 during the last quarter of the academic year. As students move to secondary education, this subject is included in the seventh, eighth, tenth, and eleventh grades (Plasabas, 2016). According to Dumale and Gurat (2023), this integration aims to enhance students' global competitiveness and equip them with crucial mathematical skills. However, in the 2022 Programme for International Student Assessment (PISA) managed by the Organization for Economic Cooperation and Development (OECD) in which 25 percent of the assessment included uncertainty and data where statistics and probability skills were tested, 49 out of 81 countries who joined the benchmark performed below the OECD average score of 474 in uncertainty and data (OECD, 2023). Moreover, a study conducted in Sukarta, Indonesia by Arum et al. (2018), emphasized that high school students encounter difficulties in solving probability problems, which involve understanding the nature of the problem, selecting and applying appropriate problem-solving strategies, and executing the computational process to solve the problem.

In the Philippines, descriptive-correlational research conducted by Calma et al. (2022) highlighted that 397 Senior High School (SHS) students from different strands in both public and private schools in Magalang, Pampanga performed below expectations in statistics and probability with a mean score of 8.864 out of 25 perfect score. Additionally, an experimental study by conducted by Eslabon et.al (2020) at West Negros SHS Department revealed that 80 selected Grade 11 STEM students got a mean score of 10.79 out of 30-item achievement test in statistics and probability interpreted as low level of achievement. Similarly, Retutas and Rubio (2021) carried out a multivariate study on selected 570 Grade 11 SHS students from both private and public, within Region XI, Mindanao. The results of their study revealed a fairly satisfactory performance among students in statistics and probability. Evidently, statistics and probability concepts are integrated into the K–12 curriculum from the early grades through Grade 10 however it is still needed to provide additional support and attention to ensure that students fully understand and comprehend these concepts (Salvan, 2014).

According to PISA 2022 Mathematics Framework, for 21st century learners to be mathematically literate, students should also possess and be able to demonstrate computational thinking skills as part of their problem-solving

practice. These computational thinking skills which are applied in formulating, employing, evaluating, and reasoning include pattern recognition, decomposition, determining which computing tools could be employed in solving the problem, and defining algorithms as part of a detailed solution. Computational thinking emerged as part of digital literacy and led to many initiatives to embed Computational Thinking in the K-12 curriculum (Yadav et al., 2016). Spreadsheet software, like Microsoft Excel (MS Excel) or Google Sheets, is a tool that can help develop computational thinking across various mathematical areas such as arithmetic, equations, trigonometry, and statistics (Sanford, 2018).

MS Excel is widely employed for mathematical calculations, statistical modeling, and making well-informed decisions based on statistical inference (George & Kumah, 2021). A study carried out in Nigeria by Benning and Agyei (2016) found that students who received instruction on creating, interpreting, and modifying statistical charts using MS Excel demonstrated better math achievement compared to those taught through traditional pen and paper methods. Additionally, a quasi-experimental study conducted by Ruqoyyah (2020) at a private university in West Java, Indonesia revealed that utilizing the Virtual Basic Application (VBA) within MS Excel led to improved academic performance among second-year education students when learning mathematical concepts, specifically related to building spaces. Also, an experimental study by Cobcobo and Mapua (2022) conducted in Paracelis, Mountain Province, found that using MS Excel increased the achievement of Grade 11 Humanities and Social Sciences (HUMSS) students in dealing with statistics problems.

The inclusion of statistics and probability within the SHS curriculum in the Philippines is recognized, bringing potential advantages through leveraging MS Excel to enhance academic achievement. Previous studies by Benning and Agyei (2016) have focused on evaluating MS Excel's impact on student performance regarding quadratic functions. While Ruqoyyah (2020) conducted a quasi-expererimental study on how MS Excel could facilitate comprehension of mathematical concepts in building spaces. Additionally, Cobcobo and Mapua (2022) did research on integration of MS Excel as a tool for teaching Grade 11 HUMSS students implemented a true experimental design. This study seeks to address the gap by applying a quasi-experimental approach to investigate MS Excel's effect on statistics and probability achievement among Grade 11 students. The earlier investigations centered on specific subject areas, yet incorporating Excel across curricula may further benefit learning in varied subjects like statistics and probability.

Theoretical Lens

Jean Piaget's Constructivist Learning Theory (1964) together with John Sweller's Cognitive Load Theory (1980), established the foundation for this study. Piaget posited that learners acquire comprehension by means of previous interactions and mental models, with a specific emphasis on hands-on experimentation. Employing computer-based instruction through MS Excel provides the students avenue to enter, manipulate and solve problems in statistics and probability on their own which will build their experiences and potentially improve their achievement in class. On the other hand, John Sweller's Cognitive Load Theory focuses on how the brain processes and stores information, indicating that cognitive load must be managed to enhance learning outcomes. According to Sweller instructional techniques should not overload working memory with irrelevant activities. To this end, MS Excel can serve as a way for introducing statistical ideas slowly and graphically until abstract calculations are reduced into simple steps. This minimizes cognitive overloading hence improves students' grasp of statistics and probability concepts leading to enhanced achievement.

METHODS

Research Design

The researcher used a quantitative approach, specifically a quasi-experimental design. According to Bhandari (2023) quantitative research is about collecting and analyzing numerical information to reveal patterns, predict future occurrences, test the relationship between variables and make inferences leading to conclusions. In this case, statistical analysis was conducted to determine if there were significant improvements in students' achievement who used MS Excel compared with those who utilized prevailing or traditional method. Furthermore, Thomas (2023) stated that quasi-experimental designs are created to establish cause-effect relationships without random assignment. Instead of randomization they employ control and experimental groups whereby the independent variable is manipulated. The study employed pretest-posttest design taking measurement of dependent variable before and after treatment (Chiang et al., 2020). The study engaged two groups of students: one group used MS Excel whereas another group used the traditional method. Both groups took the same pre-test and post-test for comparison of results.

Place of the Study

The researcher conducted the study at one of the private schools in

Davao City. This is located in Cabantian, Davao City. The researcher chose this school because the school has adequate technological infrastructure, such as computer labs making it conducive to integrating Microsoft Excel into the curriculum effectively. Also, the school's vision is to be recognized as one of the best academic institutions in the Davao region, applying relevant and modern information technology systems that are managed by the most qualified and highly dedicated faculty and staff. The selected school is the best fit for the study since its vision aligns with the goals of the study, allowing for the incorporation of additional tools like MS Excel to enhance student's learning experiences in Mathematics, particularly Statistics and Probability.

Moreover, out of the selected school's three campuses, the Grade 11 students for S.Y 2022-2023 at the selected campus had the lowest performance in Statistics and Probability, achieving an average passing rate of 43.8 percent on the post-test administered during the final week of the 2nd semester. Hence, the selected campus is an ideal setting for conducting a study on MS Excel to enhance students' learning in Mathematics, especially in Statistics and Probability. The evident need for improvement in this specific subject among Grade 11 students at this campus underscores the significance and relevance of implementing computer-based instruction, specifically using MS Excel to enhance their mathematics achievement in statistics and probability.

Respondents

The respondents of this study were 90 Grade 11 students from one of the private schools in Davao City, specifically those enrolled in the statistics and probability class, with 45 participants in each section. The researcher chose the sections from the same session schedule, specifically morning sessions. Moreover, out of four Grade 11 sections the researcher chose all- STEM section to be the control group and the section with STEM and ICT students to be the experimental group. Students from Grade 12 and Grade 11 sections with no single STEM student and students who are not enrolled in the Statistics and Probability class, and those in the afternoon session were excluded from the study.

Purposive sampling was used to select the participants of the study because, according to Foley (2018), it is a type of non-probability sampling where researchers use their discretion when selecting individuals from the population to participate in the study. This sampling strategy was chosen to ensure a representative and homogenous sample that met the criteria essential for the successful execution of the study.

Statistical Tools

The researcher utilized the mean, standard deviation, independent sample t-test, dependent sample t-test and effect size for data analysis to come up with a valid and reliable study and interpretation of the data. Mean was used to determine the level of mathematics achievement of the students. While Standard Deviation determines how much each group's data deviates from the mean and how spread out the scores in a group are. Furthermore, Independent Sample T-test was used to test whether there was a significant difference between the pre-test mean scores of the experimental group and the control group, as well as the post-test mean scores. It was also used to test whether there was a significant difference between the mean gain scores of the experimental and control groups. While Dependent Sample T-test was utilized to determine the significant difference in the scores of respondents in the pre-test and post-test within the experimental and control groups. Lastly, the Effect Size was used to determine the effect of the intervention on the scores using the pre-test and post-test results.

RESULTS

Pre-test Mean Scores of the Experimental and Control Groups

Table 1

Pre-Test Mean Scores of the Experimental and Control Groups

Topic	Group	Mean	Percent of Correct Answer	SD	Description
Understanding					
Sampling Distribution of Sample Means	Control	4.04	26.93	3.74	Fairly Satisfactory
	Experimental	2.76	18.40	3.02	Did not meet expectations
Applying					
Mean and Variance of Sample Means	Control	2.00	20.00	2.31	Did not meet expectations
	Experimental	1.98	19.80	2.62	Fairly Satisfactory
Solving problems	Control	1.56	15.60	2.23	Did not meet expectations

involving Sampling Distribution of Sample Means	Experimental	1.44	14.40	2.28	Did not meet expectations
	Control	7.60	21.71	7.50	Fairly Satisfactory
	Experimental	6.18	17.66	7.08	Did not meet expectations

Table 1 presents the pre-test mean scores for the experimental and control groups in understanding and applying domains related to the sampling distribution of sample means topics. In the understanding domain on sampling distribution of sample means, the control group scored a mean of 4.04 (26.93% correct), while the experimental group scored 2.76 (18.40% correct). In the applying domain, for mean and variance of sampling distribution of sample means, the control group scored a mean of 2.00 (20.00% correct) and the experimental group scored 1.98 (19.80% correct). For solving problems involving sampling distribution of sample means, the control group scored 1.56 (15.60% correct) and the experimental group scored 1.44 (14.40% correct). These results indicate that on the pre-test, both groups performed lower in the applying domain compared to the understanding domain.

The overall pre-test mean score of the control group is 7.60 (21.71% correct), indicating a fairly satisfactory level of academic achievement in understanding the sampling distribution of sample means. However, this suggests that students possess minimal knowledge and skills, requiring assistance from teachers or peers during tasks. On the other hand, the experimental group's overall pre-test mean score is 6.18 (17.66% correct), showing that score did not meet expectations, indicating a very low level of achievement. This is attributed to insufficient knowledge and skills in the relevant topics.

Furthermore, the control group's standard deviation is 7.50, while the experimental group's is 7.08, indicating less variability among scores in the experimental group. These results align with previous findings of Retutas and Rubio (2021) and Calma et al. (2022), whose studies revealed unsatisfactory and low level of achievement of Grade 11 students in statistics and probability. Senior high school students commonly face academic difficulties in statistics and probability due to lack of mathematical and statistical background, particularly

in topics such as permutation, combination, probability, and random variables (Kandeel, 2019).

Significance of the Difference in the Pre-test of Experimental and Control Groups

Table 2
Significance of the Difference in the Pre-test of Experimental and Control Groups

Groups	t	p-value	Remarks
Control (Prevailing Method)			
Experimental (Computer-Based Instruction)	0.925	0.358	Not significant

The difference between the pre-test mean scores of the experimental group and control group was tested under an alpha 0.05 significance level. The p-value of 0.358 presented in Table 2 is greater than 0.05, implying that there is no significant difference between the experimental and control group's prior knowledge of Sampling and sampling distribution, specifically in sampling distribution of sample mean, mean and variance of the sampling distribution of sample mean and problems involving sampling distribution of sample mean. Further, this demonstrates that the control group (M=7.60, SD=7.50) and experimental group (M= 7.18, SD =7.08) have comparable levels of understanding and applying in the topics of sampling distribution of sample mean, mean and variance of the sampling distribution of the sample mean and problems involving sampling distribution of the sample mean. Additionally, the standard deviation of the control and experimental groups is 9.01 and 5.88, respectively, indicating more clustered responses in the experimental group compared to the control group.

This result negates the findings of Cobcobo and Capua (2022), which revealed that there is a significant difference between pre-test scores of the control and experimental groups, suggesting that experimental group outperformed the control group before MS Excel implementation which is contrary to the result of this study. The result of their study however shows that both groups had low achievement prior the conduct of the study. This aligns with

the assertion of Herlina (2021) that students struggle with statistics and probability due to the complexity of data analysis and difficulty in validating solutions. Additionally, Peters et al. (2013) note that acquiring statistics and probability skills presents significant challenges due to the subject's abstract nature and the need for critical thinking.

Post-Test Mean Scores of the Experimental and Control Groups

Table 3
Post-Test Mean Scores of the Control and Experimental Groups

Topic	Group	Mean	Percent of Correct Answer	SD	Description
Understanding					
Sampling Distribution of Sample Means	Control	11.20	74.67	3.34	Very Satisfactory
	Experimental	12.73	84.87	2.40	Outstanding
Applying					
Mean and Variance of Sample Means	Control	5.78	57.80	3.17	Satisfactory
	Experimental	8.44	84.40	1.95	Outstanding
Solving problems involving Sampling Distribution of Sample Means	Control	4.11	41.10	3.01	Satisfactory
	Experimental	7.27	72.70	2.36	Very Satisfactory
	Control	21.09	60.25	9.01	Very Satisfactory
	Experimental	28.47	81.33	5.88	Outstanding

Table 3 displays the post-test mean scores for the experimental and control groups. In the understanding domain of sampling distribution of sample means, the control group scored a mean of 11.20 (74.67% correct), while the experimental group scored 12.73 (84.87% correct). For the applying domain, regarding mean and variance of sampling distribution of sample means, the control group scored a mean of 5.78 (57.80% correct), whereas the experimental group scored 8.44 (84.40% correct). Similarly, in the applying domain for solving problems involving sampling distribution of sample means, the control group scored a mean of 4.11 (41.10% correct), while the experimental group scored 7.27 (72.70% correct). These results indicate an improvement in achievement for both groups in both understanding and applying domains,

though understanding remains higher than applying cognition.

The overall post-test mean score of the control group was 21.09 (60.25% correct), described as very satisfactory, indicating a high level of academic achievement in the sampling distribution of sample means. This suggests that students have developed fundamental knowledge and skills and can independently apply them through authentic performance tasks. While the experimental group achieved an overall post-test mean score of 28.47 (81.33% correct), described as outstanding, indicating a very high level of academic achievement. This suggests that students in this group surpass core requirements in terms of knowledge, skills, and understanding, and can transfer them automatically and flexibly through authentic performance tasks. Additionally, the standard deviation of the control and experimental groups is 9.01 and 5.88, respectively, indicating that the experimental group has more clustered responses than the control group.Overall, both experimental and control group mean scores increased after the implementation of CBI through Ms Excel and traditional method, respectively.

The findings of this study align with those of Benning and Agyei (2016), who observed improved achievement among Grade 11 students in quadratic functions after utilizing the Spreadsheet Instruction Method (SIM). Similarly, technology, as noted by Batanero (2016), enhances students' motivation to learn by facilitating real data manipulation and influences statistical teaching and applications, ultimately improving comprehension. Additionally, Eslabon et al. (2019) found that traditional methods yielded high achievement levels among Grade 11 STEM students in Statistics and Probability topics, affirming the importance of traditional teaching methods in student learning.

Significance of the Difference in the Post-test of Experimental and Control Groups

Table 4

Significance of the Difference in the Post-test of Experimental and Control Groups

Groups	t	p-value	Remarks
Control (Prevailing Method)	4.601	0.000	Significant

Experimental (Computer-Based Instruction)			

Table 4 presents the p-value of 0.000 which is less than 0.05, showing that there is a significant difference between the mathematics achievement of the control group (M=21.09, SD=9.01) and experimental group (M=28.47, SD=5.88) in statistics and probability topics. Further, this demonstrates that the respondents from the experimental group performed better than the control group.

Research by Pelayo et al.'s (2019) on Grade 10 students revealed a significant difference in student achievement between the control and experimental groups. However, contrary to expectations, students from the control group, taught using traditional methods, performed better than the experimental group. This suggests that students showed better performance in mathematics lessons with traditional instruction compared to computer-based methods. Importantly, Pelayo et al.'s study employed computer-based learning utilizing various applications and programs, rather than focusing solely on MS Excel which was done in this very study.

But the result of this study aligns with Ruqoyyah (2020) whose study found that there is a significant difference between the post-test scores of students from control and experimental group. The finding of her study implied that students better understood mathematical concepts with MS Excel VBA compared to traditional methods. These findings support Jean Piaget's Constructivist Learning Theory (1964), which emphasizes active knowledge construction through prior experiences and mental frameworks. The findings confirm that utilizing MS Excel for exploring and analyzing real-world datasets allows students to actively engage and improve their achievement in statistics and probability by manipulating and visualizing data.

Difference between the Pre and Post-test Mean Scores of the Control Group

Table 5

Difference between the Pre-test and Post-test Mean Scores of the Control Group

Control Group	t	p-value	Remarks

Pre-test Post-test	19.083	0.000	Significant

Table 5 shows the difference between the pre-test and post-test mean scores of the control group. The obtained p-value of 0.000 was less than 0.05 level of significance. This indicated that there is a significant difference between the level of achievement in Statistics and Probability in the pretest and posttest of the control group. Further, the t value of 4.601 shows that the post-test mean score of control group is higher than the pre-test mean score. This shows that the prevailing method, used by the control group in discussing certain topics in statistics and probability has led to an improvement in student math achievement.

The results of this study support Benning and Agyei's (2018) experimental research, indicating a significant improvement in grade 7 students' scores from pre-test to post-test after traditional method instruction in quadratic lessons. Benning and Agyei emphasized the effectiveness of well-planned traditional teaching in enhancing student achievement. Additionally, the findings align with King et al.'s (2013) experimental study, demonstrating increased achievement in statistics lessons, including sampling distribution, through paper and pencil-based or traditional method tutorials among second-year Psychology students at UCT. Shivaramaiah (2018) highlights lectures in traditional method as a crucial and effective teaching tool, reducing the burden on students by condensing study material in an organized manner.

Difference between the Pre-test and Post-test Mean Scores of the Experimental Group

Table 6

Difference between the Pre-test and Post-test Mean Scores of the Experimental Group

Control Group	**t**	**p-value**	**Remarks**
Pre-test Post-test	31.890	0.000	Significant

The difference between the pre-test and post-test mean scores of the experimental group is shown in Table 6. The level of achievement in statistics and probability in the pretest and posttest of the experimental group shows that the obtained p-value of 0.000 was less than 0.05 level of significance. This indicated that there is a significant difference between the level of achievement in Statistics and Probability in the pretest and posttest of the experimental group. The t value of 31.890 implies that the post-test mean score of students from the experimental group is higher than the pre-test mean score. Thus, the results revealed that the experimental group performed better after the CBI was used.

The results of this study support the finding of Herlina (2021) whose study revealed that there was a significant difference between the pre-test and post-test scores of college students in after utilizing MS Excel in learning statistics and probability lesson. Additionally, the research of Gurbuz et al. (2018) on the role of CAI through MS Excel VBA on the mathematics achievement of Grade 7 students on statistics and probability revealed that there was a significant difference between the pre-test and post-test scores of the students. His study demonstrated that students' achievement improved after utilizing MS Excel VBA. Hanip (2014) claimed that using MS Excel allows teachers to create dynamic visualizations, interactive exercises, and customized learning materials that align with students' preferences and aptitudes, increasing the engagement and motivation of the students throughout the learning process.

Mean Gain Scores of the Control and Experimental Groups

Table 7
Mean Gain Scores of the Experimental and Control Groups

Groups	**Mean**	**SD**
Control (Prevailing Method)	13.489	4.742
Experimental (Computer- Based Instruction)	22.289	4.689

Table 7 displays the mean gain scores of both the experimental and control groups. The mean gain scores indicate the average improvement in mathematics achievement observed from the pre-test to the post-test for both the

experimental and control groups. The control group got a mean gain score of 13.489, while the experimental group got a mean gain score of 22.289. This indicates an improvement in the achievement of students from both groups. These findings show that while both groups demonstrated progress, the experimental group exhibited a higher increase in their achievement compared to the control group. These findings indicate that students who were taught using Computer-Based Instruction (CBI), through MS Excel, showed more academic progress compared to those who relied on the prevailing method.

The result supports the findings of the experimental research conducted in a private Indonesian school by Martiningsih (2015) on the effectiveness of MS Excel on Grade 7 students' math achievement in statistics and probability, specifically in measures of central tendency. The results shown that both the experimental (used MS Excel) and control groups (traditional method) enhanced their math achievement. Notably, the experimental group had a higher average gain compared to the control group, implying MS Excel is more effective than traditional methods for boosting math achievement in statistics and probability.

These finding also agrees with Borkulo et al (2023) whose study focused on MS Excel's effectiveness for improving computational abilities in statistics and probability, specifically in data exploration, manipulation, filtering, sorting, and representation. The design-based study showed that 11th grade students could combine data using parameterized, conditional formulas to extract dataset information and solve problems successfully with MS Excel's aid. Additionally, according to Sihombing in 2013, computer-assisted learning with MS Excel makes delivering material in class easier for teachers and more engaging for students.

Difference between the Mean Gain Scores of the Experimental and Control Groups

Table 8

Difference between the Mean Gain Scores of the Experimental and Control Groups

Groups	t	p-value	Remarks
Control	8.853	0.000	Significant

Experimental		
Effect Size (Cohen's d)	**1.87**	**Very Large**

***Significant at 0.05 level of significance: Cohen's d: Very small (0.01), Small (0.20), Medium (0.50), Large (0.80), Very Large (1.20), Huge (2.0)*

The difference between the mean gain scores of the experimental and control groups is shown in Table 8. The obtained p-value of 0.000 which is less than 0.05 level of significance indicates that there is a significant difference between the mean gain scores of the experimental and control groups. Further, the t-value of 8.753 indicates that the mean gain scores of the students from the experimental group which employed the CBI method is significantly higher than the control group (M= 13.489, SD = 4.7) which utilized the prevailing method.

Additionally, Cohen's d-value of 1.87 representing a very large effect size. This means the difference between the mean gain of control and experimental groups is very large, suggesting a very strong impact of CBI through MS Excel compared to prevailing method on increasing students' achievement in certain topics of statistics and probability.

The result supports the findings of a quasi-experimental study of Mulle (2023) on the effects MS Excel spreadsheet application on performance of first year college students in data management in mathematics in modern world. Her study showed that there was a significant difference between the mean gain score of the control (traditional method) and experimental (spreadsheet application) groups. The finding implied that the use of MS Excel spreadsheet outperformed the traditional method in improving students' performance. Moreover, the research of Gasigwa et al. (2022) on MS Excel integration on math achievement of Grade 11 students in statistics, showed a significant difference on the achievement of students utilizing MS Excel and traditional method. The results implied that students gained higher score after being exposed to MS Excel than traditional method.

Furthermore, the results of this study support the Cognitive Load Theory by John Sweller (1980) which emphasizes the importance of managing cognitive load of students. The high mean gain of the experimental group proved that MS Excel facilitates the gradual introduction of statistical concepts, breaking down

complex calculations into manageable steps leading to enhanced academic achievement. Additionally, through MS Excel, ICT skills, solving skills and analytical skills of students are developed that led to their enhanced achievement in solving statistics problems, (Calma et. al, 2020).

CONCLUSION

In the light of the findings, the following conclusions were drawn. Firstly, in the pre-test, the control group has a low level and the experimental group has a very low level of achievement in sampling distribution of sample mean, mean and variance of the sampling distribution of the sample mean and problems involving sampling distribution of the sample mean before the conduct of the CBI using MS Excel based on the standards of DepEd Order No. 8 s. 2015. Secondly, the control and experimental groups have almost the same level of achievement statistics and probability topics before the conduct of CBI. Notably, after the conduct of the prevailing method to the control group, the level of achievement improved from a low level to a high level. While, after the conduct of computer-based instruction to the experimental group, the level of achievement increased from a very low level to a very high level of achievement in sampling distribution of the sample mean, mean and variance of the sampling distribution of the sample mean and problems involving sampling distribution of the sample mean. Consequently, the students who were taught using CBI had a higher level of achievement compared to students taught using the prevailing method. These findings show that computer-based instruction through MS Excel is effective in increasing students' achievement in certain topics in statistics and probability.

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