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Improving Students' Retention in Mathematics Using Excel Spreadsheet Software Package in Port Harcourt, Nigeria

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Abstract

This study investigated the use of Excel spreadsheet software to improve students' retention in Mathematics in Port Harcourt. It aimed to compare the retention of students taught measures of central tendency using Excel with those taught using the deductive method and to determine if retention differed between male and female students taught with Excel. A quasi-experimental research design was employed. A sample of 133 students was selected from a population of 4,584 public junior secondary school students in Port Harcourt Local Government Area, Rivers State, using purposive sampling. Data were collected using a validated Measures of Central Tendency Retention Test. The experimental group used the Excel spreadsheet software package, while the control group used the deductive method. Analysis was conducted using mean, standard deviation, and analysis of covariance at a 0.05 significance level. The findings of the study revealed that the Excel spreadsheet package significantly enhances students' retention. Additionally, male students taught with the Excel spreadsheet package demonstrated higher retention than their female counterparts, though the difference was not statistically significant. It was recommended, among other suggestions, that Excel spreadsheets be used to teach measures of central tendency to improve students' retention.

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INTRODUCTION

Mathematics is a required subject in both elementary and secondary education in Nigeria. In order to achieve both of Nigeria's primary school aims, preparation for life and higher education, and the goals of Mathematics teaching in schools were defined. Therefore, it stands to reason that Mathematics curricula should mirror contemporary values and attitudes. The direction of society has an inextricable impact on how Mathematics is taught in the classroom. The current age, known as the "digital era," is defined by the widespread adoption of technological solutions to a wide range of societal issues.

Students, teachers, and non-teaching staff all make use of technological tools in the classroom. The ability to utilize computers, the internet, and other types of software and applications is essential for anybody working in a technological field. Technology's application in the classroom has mostly focused on the teaching and learning environment. Scharaldi (2020) claims that the employment of electronic devices in the classroom to teach Mathematics improves students' achievement and retention in Mathematics and other disciplines.

Both all-purpose and subject-oriented programs are useful in the classroom, and both types of software have their place in the study and instruction of Mathematics. Spreadsheet software like Excel is an example of multipurpose software. Spreadsheet software like Microsoft Excel is pre-installed on most desktop and portable computers and may be used to compile and analyze numerical data.

According to Sadiku et al. (2017), today's students have grown up with computers and other digital technologies and are thus adept at using these tools for educational purposes. Many mathematical concepts may be taught using an Excel spreadsheet. Measures of central tendency, measures of dispersion, bar graphs, histograms, pie charts, graphs of different mathematical equations, and frequency distributions are only few of the subjects that may be taught with the use of Excel spreadsheets (George & Kumah, 2021). Excel may be a useful tool for teaching mathematical concepts, but only if the instructor has the technical pedagogical content knowledge to make the most of the software and hardware at their disposal.

In the 9-year basic education Mathematics curriculum for junior secondary schools (Federal Ministry of Education, 2012), measures of central tendency are covered within the subject of daily statistics. Quantitative data isn't complete without measures of central tendency. Therefore, it is a crucial component of any Mathematics education. Central tendency measurements, as established by DuBose et al. (2023), describe how closely related data points cluster around a given value. The mean, median, and mode are three measures of central tendency that may be calculated from either individual or aggregated data. In a research on the impact of using a digital spreadsheet on students' performance in graphing quadratic equations, Ucheson (2018) showed that using a spreadsheet boosted both students' grasp of the idea and their ability to apply it in real-world situations. Yerta (2020) provided support for the aforementioned claim by noting that the vast majority of today's students welcome the opportunity to learn in a digital environment.

The mathematical programs fall into several groups due to their specialized nature. Mathematical software includes GeoGebra, Matlab, Color Mathematics, OCTAV, Scrib, Geotan, and many more. These user-friendly, engaging applications may be used in the classroom to teach students of all ages and abilities a wide range of mathematical topics. Nwachukwu (2019) argued, however, that most mathematical software is too costly; therefore, schools seldom buy it for use in the classroom. Mathematics software used to teach mathematical concepts in schools is scarce; therefore, amidst the dearth or absence of subject-specific mathematical software, teachers can resolve to use Excel spreadsheets to teach some of these mathematical concepts. Measures of central tendency for grouped data are more difficult to calculate manually than for ungrouped data. Both teachers and students benefit from a renewed enthusiasm for mathematics instruction when students are exposed to the topic via the use of accessible technological tools.

A student's conceptual comprehension of measures of central tendency for grouped data may be bolstered by exposure to those for ungrouped data at the junior secondary level. Integrating technology into the classroom is one way to ensure that students learn about measures of central tendency for ungrouped data. Spreadsheet software is preinstalled on most computers and may be downloaded for free. Data in rows and columns may be easily captured and manipulated in a spreadsheet.

Microsoft Excel for Mathematics Instruction

Computation in mathematics can be carried out manually with the use of paper and pencil or digitally with the use of technology. The use of technology has increased due to the popularization of modern technological gadgets and requires computers and software packages. Tellu (2019) opined that software packages are classified into general and subject-specific categories, with mathematics software as an example of specific-bound software. Mathematics software can only be used by those who specialize in the discipline of mathematics. However, some software are not discipline- or subject-bound, and one such software is the Excel spreadsheet.

The Excel spreadsheet is defined as a piece of paper or computer program that is partitioned into rows and columns for the recording and computation of data. This indicates that a spreadsheet can be manually prepared and used for computation. Dennis (2015) views the greatest demerit of the paper spreadsheet as its inability to be manipulated electronically with icons for fast processing of data. The use of spreadsheets as a learning tool to explore abstract concepts in computational subjects such as mathematics, physics, chemistry, economics, accounting, and finance has increased in the present era due to the rapid adoption of technology in the classroom (Dania & Anakwe, 2019). Spreadsheets have emerged as an essential tool for solving problems in mathematics and conducting 'what if' dynamic scenarios. The use of spreadsheets has made it possible to solve lengthy mathematical problems with bulky data points in less time. It has also aided in reprocessing archived data without lengthy procedures. Other benefits of spreadsheets include the easy use of big data analysis, formulas, and graphical output without utilizing advanced computer programming.

There are different types of spreadsheet packages that can be employed to solve computational problems. The most popular spreadsheet among users is the Microsoft Excel spreadsheet. Microsoft has over 300 million paid users of their popular version of the Excel spreadsheet program (Spataro, 2021). The unpaid users have pirated versions of the Microsoft Excel program, which has increased its users geometrically. The Excel package is widely used for mathematical computation, statistical modeling, and decision-making with regard to statistical inference. Hence, Excel has become a preferred package for mathematicians and statisticians. Excel is by far the leading version of spreadsheet software in the market today (Hopskin, 2019). The survey research investigation by Agwo (2020) revealed that 93% of mathematics teacher and student respondents indicated that they preferred to use Excel for computation.

As a problem-solving tool, spreadsheets aid students in visualizing the underlying mathematical concepts, thus paving the way for an intuitive approach that leads to the comprehension of the "what if" scenario that always springs up in every mathematical problem-solving.

Computer Hope (2021) listed the following as examples of spreadsheet programs available for public use: Google Sheets, Work Number, Lotus 1-2-3, Lotus Symphony, LibreOffice, OpenOffice, Microsoft Excel, and VisiCalc. Other types of spreadsheet programs, according to Jotform (2021), are Apple Numbers, QUP, Ether Calc, Zoho Sheets, Smartsheet, and Apache OpenOffice.

Pemberton and Robson (2000) stated that spreadsheets play a central role in the daily administrative tasks of many businesses. Spreadsheet software can help capture, manipulate, run analysis, and present data related to specific areas of operation. Spreadsheets are used in various ways, such as for financial, statistical, presentation, and future planning. The most popular spreadsheet package is the Microsoft Excel package. The Microsoft Excel spreadsheet package comes as a suite, which consists of their packages such as Microsoft Word, Microsoft Office, Microsoft PowerPoint, Microsoft Outlook, and Microsoft InfoPath Designer. There are various versions of the Microsoft Excel package, and the newer versions are updated versions of older versions. The versions that are currently used are 2010 and 2016.

Excel Spreadsheet and Students' Retention

Many research findings support the positive effect of Microsoft Excel spreadsheet-based instruction on student retention. Iji et al. (2022) conducted a study titled "Utilizing Microsoft Excel spreadsheet technology to improve senior secondary school students' achievement and retention in quadratic functions in Nigerian education." This study examined the effect of MS Excel spreadsheet technology on senior secondary two students' achievement and retention in quadratic function graphs in Education Zone C, Benue State, Nigeria. Research questions were answered using means, standard deviations, and percentages (scattergrams), while hypotheses were tested using Analysis of Covariance (ANCOVA) at the 0.05 level of significance. The results of the study showed, among other things, that SS2 students taught quadratic function graphs using MS Excel spreadsheet technology improved more in their achievement and retention, with no gender difference.

On the other hand, Massekela and Bongasella (2020) conducted a study titled "Effects of Microsoft Excel spreadsheet on tertiary students' performance and retention in data coding." The experimental group was taught with bar graphing using Microsoft Excel spreadsheets, while the control group was taught the same topic using the deductive teaching method, which required no spreadsheet. The undergraduate students in both groups were pretested, posttested, and post-posttested. The mean and standard deviation were used to answer the research questions, while ANCOVA was used to test the hypotheses at the 0.05 significance level. The results showed that the undergraduate students in the control group, who were taught without a spreadsheet, had higher retention than those in the experimental group. The results also showed that there was no statistically significant difference between the retention of undergraduate students taught with Microsoft Excel spreadsheets and those taught without a spreadsheet. Olaniya and Enbeli (2020) carried out a study titled "Enhancing junior secondary school students' performance and retention in the construction of pie charts in Ondo State," which revealed that the students who were taught the construction of pie charts using Lotus Symphony had higher retention than those taught using the paper-and-

pencil method. There was also a statistically significant differential effect on the two groups.

Also, in another study by Agala et al. (2020), which investigated the effects of the use of spreadsheets on the performance and retention of senior secondary school students in graphing mathematical functions, the results showed that students in the experimental group who were taught with spreadsheets had higher retention than the students in the control group, who were taught with the conventional teaching method. Obiajunwah (2019) carried out a study on the effect of the use of spreadsheet software packages on senior secondary school students' retention in algebra. The study presented one experimental and one control group, and the findings showed that the use of spreadsheet packages to teach algebra improved students' retention in algebra.

Furthermore, Ogale (2019) examined the effect of Microsoft Excel spreadsheets on the performance and retention of students in geometrical visualization. Ogale's results showed that students in experimental group two, who were taught with spreadsheets, had higher retention than the students in the other two groups. When subjected to statistical testing, it was revealed that there was a significant difference in the retention of students who were taught with spreadsheets and those who were not taught with spreadsheets in the other two groups. Ajah (2017) carried out a study titled "Use of Spreadsheet and Senior Secondary School Students' Retention in Mathematics," and the results revealed that students in the experimental group, who were taught with spreadsheets, had higher retention than the students in the control group, who were taught without spreadsheets but rather with paper and pencil.

Gender and Excel Spreadsheet

Uchendu et al. (2021) found that the female students who were taught with a spreadsheet package had higher retention than their male counterparts, who were also taught with the spreadsheet in the same group, though there was no significant difference in retention. The study examined the effect of using a computer spreadsheet package on students' performance in teaching and learning Mathematics. The sample for the study consisted of eighty-five students (41 experimental, 44 control) from two middle schools. A reliable and validated instrument titled Mathematics Retention Test (MRT) was used to collect data. The student *t*-test and the *Mann–Whitney U* test were used for statistical analysis at 0.05 significant level.

Another study was conducted by Haruna (2020), who provided a detailed description of the impact of spreadsheets on students' academic retention in Mathematics. The researcher found that male students in the experimental group, who were taught with spreadsheets, had higher retention than their female counterparts, though there was no significant difference in their retention mean scores. Ekpet (2017) concluded that male students in the experimental group, who were taught with a spreadsheet package, had higher retention than their female counterparts in the same group. The findings also revealed that there was no significant difference in the retention of male and female students who were taught using the spreadsheet package.

From the empirical review, it was observed that Microsoft Excel spreadsheets were used by many researchers due to their popularity. It was also observed that various Mathematics concepts, such as bar charts, measures of central tendency,

basic operations, and pie charts, have been taught using Microsoft Excel spreadsheets. The review found that researchers have conducted numerous studies on the use of spreadsheets to teach various Mathematics concepts in different areas, but none were conducted in the Port Harcourt Local Government Area of Rivers State to the researcher's best knowledge. This constituted a gap that this study intended to fill. This study was conducted in the Port Harcourt Local Government Area of Rivers State to explore the use of Excel spreadsheets in improving students' retention in measures of central tendency in Mathematics.

Statement of the Problem

Mathematical topics in public junior high schools have traditionally been taught using teacher-centered techniques that are uninteresting and boring for students, leading to low achievement and retention. According to Table 1; The Chief Examiner's Report (2020), students' low performance in Statistics-related topics in General Mathematics may be attributed to the fact that many of them avoid problems that are directly connected to the Everyday Statistics subject of the Mathematics curriculum. One of the innovative approaches to teaching and learning Mathematics in the twenty-first century, often known as the digital age, is the use of computers and Mathematics software. Therefore, the purpose of this research was to answer issues that may have arisen from the above about the impact of the Excel spreadsheet software package on students' academic performance and retention through junior secondary school.

Table 1. Nigeria's WASSCE General Mathematics Performance (2000–2020)

Year of Exam	Total students who took General Mathematics	% of students with credit and above (A1-C6)	% of students with (D7-F9)
2000	530,074	32.80	67.20
2001	843,991	41.60	58.40
2002	949,139	15.00	85.00
2003	518,516	45.80	54.20
2004	1,051,246	53.80	46.20
2005	1,091,763	35.55	64.45
2006	1,184,223	39.94	60.06
2007	1,275,330	15.56	84.44
2008	1,369,142	23.00	77.00
2009	1,373,009	31.00	69.00
2010	1,351,557	33.55	66.45
2011	1,540,250	38.93	61.07
2012	1,675,224	49.00	51.00
2013	1,543,683	36.00	64.00
2014	1,692,435	31.30	68.70
2015	1,593,442	34.18	65.82
2016	1,544,234	38.68	61.32
2017	1,559,162	59.22	40.78
2018	1,572,395	47.98	52.02
2019	1,590,173	48.15	51.85
2020	1,538,445	34.75	65.25

Aim and Objectives of the Study

The aim of this study was to investigate the optimizing students' retention of junior secondary school students in Mathematics (measures of central tendency) using Excel spreadsheet software package in Port Harcourt. Specifically, the objectives of the study were to: (1) ascertain if there is any difference between the retention of students taught measures of central tendency using Excel spreadsheet software package and those taught using the deductive teaching method, and (2) determine whether there is any difference between the retention of the male and the female students taught measures of central tendency using Excel spreadsheet software package.

Research Questions

The following research questions were raised and answered: (RQ1) How does the retention mean score of students taught measures of central tendency using Excel spreadsheet software package and those taught using the deductive teaching method differ?; (RQ2) Is there a difference in the retention mean score of the male and the female students taught measures of central tendency using Excel spreadsheet software package in the experimental group?

Hypotheses

Two null hypotheses were tested at 0.05 level of significance: ($H_0$1) No significant difference exists between the retention mean score of students taught measures of central tendency using Excel spreadsheet software package and those taught using the deductive teaching method, and ($H_0$2) No significant difference exists between the retention mean score of the male and the female students taught measures of central tendency using excel spreadsheet software package in the experimental group.

RESEARCH METHODS

In order to achieve the two objectives of the study, which are: (1) to ascertain if there is any difference between the retention of students taught measures of central tendency using the Excel spreadsheet software package and those taught using the deductive teaching method, and (2) to determine whether there is any difference between the retention of male and female students taught measures of central tendency using the Excel spreadsheet software package, the following methods were used to achieve the objectives.

Research Design

The study employed a quasi-experimental design, which involved a pre-test, post-test, non-randomized, and non-equivalent control group. Intact classes were used to avoid disrupting the normal school programs for experimental purposes. According to Nwankwo (2013), a quasi-experimental study is a study in which some threats to validity cannot be fully controlled due to the involvement of human participants in the experimental study. The study utilized human participants whose experiences were influenced by both internal and external factors beyond the researcher's control, including teacher variables and initial group differences. Another reason

this method was chosen was that it keeps classrooms intact instead of randomly assigning students to groups (Gopalan, 2020). This scheme compared two groups: an experimental group and a control group. Table 2 provides details of the methodology that guided our research.

Table 2. Study Design

Group	Pretest	Treatment	Posttest	Post-Posttest
EG	O_1	X_{ESS}	O_2	O_3
CG	O_1	X_{DTM}	O_2	O_3

Note: EG= Experimental Group, CG= Control Group, X_{ESS}= Treatment using Excel Spreadsheet, X_{DTM} = Treatment using Deductive Teaching Method, O_1= Pretest for experimental and control groups, O_2= Posttest for experimental and control groups, O_3= Post-Posttest for experimental group and control group.

Study Area

The Port Harcourt Local Government Area, in Rivers State, was chosen as the study area because it is a predominantly urban environment that includes people from all social classes. The area has a high concentration of educational activities, as many tertiary institutions in Rivers State are located here, including Rivers State University and the School of Nursing and Midwifery, alongside numerous primary and secondary schools (both private and public). Port Harcourt Local Government is situated in the Niger Delta region of the South-South geopolitical zone. It is one of the 23 local governments in Rivers State, Nigeria, and Port Harcourt City serves as its administrative center. According to a map of Nigeria available on ResearchGate.net, the local government is located between longitude $4^{0}40^{1}$E and $4^{0}55^{1}$E, and latitude $6^{0}58^{1}$N and $7^{0}6^{1}$N. Port Harcourt is situated 52 kilometers south of Ahoada and 40 kilometers northeast of Bori. To the south is Okrika, to the east is Eleme, to the north is Obio-Akpor, and to the west is Degema. The indigenous people of Port Harcourt speak Ikwerre as their first language. The economy is primarily based on farming, fishing, and commerce, with the urban industrial settlement creating a variety of white-collar job opportunities, contributing to the city's high population density. Rivers State is known as the "Treasure Base of the Nation" due to its significant contributions to Nigeria's economy.

The Port Harcourt LGA has 18 junior secondary public schools. The region is also home to several tertiary institutions, including Rivers State University, Rivers State University Teaching Hospital, Ignatius Ajuru University of Education (which has two campuses), and Captain Elechi Amadi Polytechnic (with schools of health, nursing, and law). Numerous private and public primary and secondary schools further contribute to the area's high concentration of educational opportunities. In addition, it hosts various corporations. The population of the Port Harcourt LGA is estimated at 3,171,000, residing within a 109-square-kilometer area, according to the 2016 census (Macrotrends LLC, 2024).

Population, Sample, and Sampling Technique

The population of the study consisted of all the four thousand five hundred and eighty-four (4,584) junior secondary one (JS1) students in the eighteen (18) public junior secondary schools in Port Harcourt Local Government Area of Rivers State.

The sample for this study consisted of one hundred and thirty-three (133) public junior secondary one (JS1) students from Port Harcourt Local Government Area of Rivers State. Purposive sampling was used to select two co-educational schools from the 18 junior secondary schools in the area. The criterion was the inclusion of co-educational public junior secondary schools with functional computer laboratories (to ensure consideration of gender and availability of computers). Subsequently, a simple random assignment technique was employed to categorize the two selected schools into experimental and control groups. Additionally, a further random sampling method selected one intact JS1 class from each of the two schools. Table 3 presents the sample distribution for the study.

Table 3. Sample Distribution

Group	Male	Female	Total
Experimental	25	37	62
Control	34	37	71
Total	59	74	133

Research Instrument

The instrument used for data collection is the "Measures of Central Tendency Retention Test (MCTRT)". The instrument was used to measure the retention of students in measures of central tendency (mean, median, and mode) of ungrouped data with respect to gender. The instrument, MCTRT consisted of twenty-five (25) multiple-choice questions in measures of central tendency. Each test item of MCTRT had four options from which students were asked to select only one correct answer by ticking. The other three options were the distractors of the test items. The items of MCTRT were derived from the contents that were taught during the treatment session. A test blueprint was prepared to guide the distribution of the test items into lower and higher order Bloom's cognitive educational taxonomy.

Each test item in the MCTRT was allotted 4 marks. This means that each correct response from the students was awarded 4 marks, while each incorrect response was given zero marks. The MCTRT was graded in percentages. Six sets of lesson plans were prepared by the researcher for teaching the three specified Mathematics concepts (mean of ungrouped data, median of ungrouped data, and mode of ungrouped data) to the experimental and control groups. The topics and specific instructional objectives of the lesson plans for both groups were identical. The lesson plans differed in teaching methods: the experimental group used demonstration with spreadsheets, while the control group used deductive teaching without spreadsheets.

Validity of Instrument

The instrument, MCTRT was subjected to face and content validation. The validation was carried out by two experts from Mathematics education. The abnormalities which were observed and pointed out by the experts were corrected to arrive at the final instrument before administering to the sample.

Reliability of Instrument

The test-retest reliability approach was used to assess the instrument's reliability. Thirty (30) students in JS1 who were from a school that did not participate in the

main study were used to ascertain the reliability of MCTRT. The thirty students were administered with MCTRT without any form of teaching. After 14 days, the same MCTRT was administered to the students for the second time. The second test of MCTRT was re-shuffled to avoid students' mastery of the items in the instrument. The first and second tests were marked in percentage by the researcher and coded for analysis. The two sets of test scores from the thirty students were correlated using the Pearson product moment correlation. A correlation coefficient of 0.81 was established for MCTRT.

Method of Data Analysis

The analysis of covariance (ANCOVA) was employed to test the null hypotheses at the 0.05 significant level while the mean and standard deviation were used to answer the research questions using SPSS (Statistical Package for Social Sciences version 25).

RESULTS AND DISCUSSION

RQ1 examined the difference in retention scores between students taught with ESSP and DTM. The results of the descriptive statistical analysis of students' retention scores based on the teaching method groups are summarized in Table 1.

Table 4. Retention Scores by Teaching Method

Group	N	Post-test		Post-Posttest		Retention Gain	
		Mean	SD	Mean	SD	Mean	SD
ESSP	62	51.49	13.46	74.52	12.51	23.03	8.10
DTM	71	45.07	12.64	57.95	13.77	12.88	10.53

Note: ESSP= Excel Spreadsheet Software Package; DTM= Deductive Teaching Method.

Based on Table 4, students taught with ESSP achieved a retention gain significantly higher (M=23.03, SD=8.10) than those taught via DTM (M=12.88, SD=10.53). The data analyzed in Table 4 showed that students taught measures of central tendency with the spreadsheet software package had a higher retention mean gain than the students taught with the deductive teaching method. To determine whether this observed difference is statistically significant, $H_0$1 was tested. The results of the analysis testing $H_0$1 are presented in Table 5.

Table 5. ANCOVA Summary on Students' Retention with ESSP vs. DTM

Source	Type III Sum of Squares	*df*	Mean Square	*F*	*p*-value
Corrected Model	26269.645*	2	13134.822	424.745	0.000
Intercept	4093.901	1	4093.901	132.386	0.000
Posttest	7334.742	1	7334.742	237.186	0.000
Gender	3211.261	1	3211.261	103.844	0.000
Error	2566.692	130	30.924		
Total	366025.000	133			
Corrected Total	28836.337	132			

Note: *R Squared = .911 (Adjusted R Squared = .909)

In Table 5, the results indicate a significant difference in retention between the ESSP and DTM groups ($F_{(1,130)}$=103.844, *p*-value<0.05), with students in the ESSP group showing notably higher retention. To further explore the differences in retention between the ESSP and DTM groups, a post hoc test was conducted, and the results are summarized in Table 6.

Table 6. Post Hoc Test Summary of Students' Retention in ESSP and DTM

Methods		Mean Difference	Std.	Sig.	95% Confidence Interval	
(I)	(J)	(I-J)	Error		Lower	Upper
ESSP	DTM	40.25*	2.72	.00	33.52	46.98

Note: *The mean difference is significant at the 0.05 level.

In Table 6, the results indicate that the test between DTM and ESSP was statistically significant (-40.25, Sig.=0.00; *p*-value<0.05) and in favour of ESSP. Also, the test between ESSP and DTM was statistically significant (MD=40.25, Sig.=0.00; *p*-value<0.05) and in favour of ESSP. Building on the significant findings from Table 6, RQ2 further investigates whether gender influences retention scores among students taught with ESSP in the experimental group.

RQ2 explores whether there is a difference in retention scores between male and female students taught with ESSP in the experimental group. The results of the descriptive statistical analysis of students' retention scores based on gender groups are summarized in Table 7.

Table 7. Retention Scores by Gender (Male vs Female)

Group	Gender	N	Posttest		Post-Posttest		Retention Gain	
			Mean	SD	Mean	SD	Mean	SD
ESSP	Male	25	55.87	13.05	80.69	12.59	24.82	12.32
	Female	37	47.11	12.73	68.35	14.87	21.24	11.78

Based on Table 7, male students taught with ESSP had a higher retention gain (M=24.82, SD=12.32) than their female counterparts taught with ESSP (M=21.24, SD=11.78). It is evident from Table 5 that male students who were taught measures of central tendency using the Excel Spreadsheet Software Package (ESSP) had higher retention than their female counterparts in the same experimental group. To determine whether this observed difference is statistically significant, $H_0$2 was tested. The results of the analysis testing $H_0$2 are presented in Table 8.

Table 8. ANCOVA Summary on Male and Female Students' Retention with ESSP

Source	Type III Sum of Squares	*df*	Mean Square	*F*	*p*-value
Corrected Model	3494.248*	2	1747.124	60.977	0.000
Intercept	3689.749	1	3689.749	128.778	0.000
Posttest	3104.057	1	3104.057	108.336	0.000
Gender	34.448	1	34.448	1.202	0.279
Error	1317.997	59	28.652		
Total	284200.000	62			
Corrected Total	4812.245	61			

Note: *R Squared = .866 (Adjusted R Squared = .837)

In Table 8, the result showed that there is no significant difference in the retention between the male and the female students taught measures of central tendency using ESSP ($F_{(1,59)}$= 1.202, *p*-value= 0.279> 0.05).

Excel Software and Student Retention in Mathematics

Table 4 shows that students who were taught measures of central tendency using the Excel Spreadsheet Software Package (ESSP) in the experimental group had a retention mean gain of 23.03 (SD=8.10), while those taught using the deductive teaching method (DTM) in the control group had a retention mean gain of 12.88 (SD=10.53). The data analyzed in Table 4 indicates that students taught measures of central tendency with the spreadsheet software package had a higher retention mean gain than those taught with the deductive teaching method.

This aligns with the findings of Ogale (2019), which similarly revealed that using Microsoft Excel Spreadsheet for teaching resulted in higher retention scores. Ajah (2017) also found that students in the experimental group who were taught with spreadsheets had higher retention compared to students in the control group who were taught without spreadsheets but instead with paper and pencil. Similarly, Agala et al. (2020) demonstrated that students in the experimental group who were taught with spreadsheets had higher retention than those in the control group taught using the conventional teaching method. Furthermore, Obiajunwah (2019) reported that the use of spreadsheet packages to teach algebra improved students' retention in algebra. Ekpeyong et al. (2017) also found that students taught with computer-assisted instruction had higher retention than those taught using traditional teaching methods.

These findings are further supported by the hypothesis testing results presented in Table 6, which indicate a significant difference in retention between the ESSP and DTM groups ($F_{(1,130)}$= 103.844, *p*-value= 0.000< 0.05), with students in the ESSP group showing notably higher retention. This finding agrees with Ogale's (2019) study, which similarly identified a significant difference in the retention of students taught with spreadsheets compared to those taught without them. Ekpeyong et al. (2017) also reported statistical significance in their findings.

Retention of Male and Female Students Taught Mathematics with Excel

The data in Table 5 revealed that male students taught with the ESSP had a retention mean score of 24.82 (SD=12.32), while female students taught with the ESSP in the same group had a retention mean score of 21.24 (SD=11.78). This shows that male students who were taught measures of central tendency using the Excel Spreadsheet Software Package had higher retention than their female counterparts in the same experimental group. This result aligns with the findings of Ekpet (2017), which similarly revealed that male students taught with a spreadsheet package had higher retention than their female counterparts in the same group. Haruna (2020) also found that male students in the experimental group taught with a spreadsheet had higher retention than their female counterparts. However, this result contradicts Uchendu et al. (2021), which revealed that female students taught with a spreadsheet package had higher retention than their male counterparts who were also taught with a spreadsheet in the same group.

These findings are further supported by the hypothesis testing results, as shown in Table 7, where the analysis indicated no significant difference in the retention of

male and female students taught measures of central tendency using the ESSP ($F_{(1,59)}$=1.202, p-value=0.279>0.05). This aligns with Ekpet (2017), which found no significant difference in the retention of male and female students taught using a spreadsheet package. Similarly, Haruna (2020) and Uchendu et al. (2021) also established that there was no significant difference in the retention mean scores of male and female students taught with a spreadsheet.

CONCLUSION

Based on the findings of the study, it was concluded that the use of the Excel Spreadsheet Software Package significantly enhanced the academic retention of students in measures of central tendency more than the deductive teaching method. However, the use of the Excel Spreadsheet Software Package did not result in any statistically significant difference in the academic retention of male and female students in measures of central tendency.

The following recommendations were made based on the findings of the study: (1) students should accept and embrace the use of technology and mathematics software (Excel Spreadsheet) to improve their retention of taught mathematics concepts; (2) mathematics teachers should embrace the use of technology, as it has been empirically proven that the use of technology, such as the Excel Spreadsheet Software Package, is more effective in improving retention; and (3) all students, regardless of gender, are encouraged to use technology, since there is no evidence showing a significant difference in retention between male and female students.

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