ENHANCING STUDENT'S PERFORMANCE AND ATTITUDE IN STATISTICS THROUGH THE USE OF JAMOVI SOFTWARE

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***Abstract*— The study assessed the effectiveness of the JAMOVI software in improving the attitude and academic performance of students in Statistics. A quasi- experimental and descriptive methods was involved. The study reveals that JAMOVI Statistical Software significantly enhances students' performance and attitudes in statistics education. The intervention resulted in notable improvements in academic performance, with the experimental group achieving higher posttest scores than the control group. Additionally, the intervention led to positive changes in students' attitudes towards statistics, increasing their confidence in statistical and technological competencies. These findings highlight the potential of technology-based tools like JAMOVI to improve statistics education by providing engaging, hands-on learning experiences and fostering a more positive learning environment. The significant improvement in both performance and attitude underscores the value of integrating modern statistical software into the curriculum to better support students' learning outcomes.**

Keywords— *Statistics Learning, Technology Integration, JAMOVI, Academic Performance, Attitude*

I. INTRODUCTION

Probability and Statistics offer a broad overview of descriptive and inferential statistics, traditionally taught through textbooks, lectures, and chalk and board drills. Many studies have revealed the importance of statistics in the educational context. As a branch of mathematics, statistics is a crucial tool for data analysis and interpretation across various fields (Yadav, 2020; Zorić, 2021). It involves the systematic arrangement of data and is used in natural and social sciences, life sciences, commerce, management, and technology (Yadav, 2020). The application of statistics has become increasingly important with the rise of big data and the need for professionals who can analyze and make sense of it (Zorić, 2021). In daily life, statistics is used to navigate uncertainty and make informed decisions (Xu, 2024). Statistics as a branch of mathematics has seen a focus on localized and context-driven instructional materials (Dayta, 2022), technology-based tutorials for probability problem-solving (Zamora, 2022), and the use of statistical investigation to assess students' performance (Obrial, 2020). These studies highlight the need for improved teaching methods and the development of students' statistical understanding.

Recent technological advancements present innovative teaching methods that align with the 21st-century educational landscape. Integrating technology in classrooms fosters active and collaborative learning, nurtures student independence, and emphasizes task-based instruction. Despite these benefits, statistics is often perceived as dull and intimidating, leading students to rely on rote memorization rather than genuine understanding, resulting in low engagement. Various studies have highlighted the benefits of technology in teaching statistics. Bukhatwa (2022) and Asmat (2020) found that the use of multimedia resources and computer-aided software improved student performance. Suhermi (2020) emphasized the role of technology in enhancing student statistical literacy, particularly through computers and smartphones accessing online resources and statistical software. Rohayati (2020) discussed the potential of technology to make statistics teaching more engaging and relevant in the digital era. These studies collectively underscore the positive impact of technology on statistics education.

Several studies highlighted the topics and challenges faced by students in learning Statistics. Topics in statistics include data gathering and organization, measures of central tendency, measures of dispersion (including range and variance), measures of relative position, probabilities and normal distribution, and linear regression and correlations (CHED, 2017). Studies have shown that students in higher education often struggle to grasp statistical principles and concepts (Anif et al., 2021; Uyen et al., 2021). Statistics is frequently regarded as boring, burdensome, and intimidating, leading students to memorize formulas without understanding, which is considered a low level of learning (Mufit et al., 2020). Obrial (2020) noted that most students

have low levels of statistical understanding and performance, facing challenges in formulating research questions, relying solely on surveys for data collection, and presenting and interpreting results.

Attitude, encompassing an individual's thinking, acting, and behavior, significantly impacts learning outcomes. Recent research highlights that students generally have positive attitudes towards technology in learning statistics, finding it helpful and interesting (Kızıl, 2020; Naveh, 2020; Peñaflor-Espinosa, 2020). Students prefer using mainstream, commercially available technologies for learning and perceive technology as a learning tool (Naveh, 2020). The use of technology in education is seen as a way to improve the quality of education (Kızıl, 2020). The presence of a learning community, particularly one that is task-oriented, can further enhance students' attitudes towards computer-based statistics (Sagala, 2021).

A range of studies have explored the use of technology in teaching and learning statistics in the Philippines. Matias (2021) found that the Learner Information System was positively accepted by teachers, with system quality and facilitating conditions being significant predictors of their attitudes. However, Javier (2022) noted limited practices in using digital teaching and learning technologies during the COVID-19 pandemic, particularly among public high school teachers. To address this, the Department of Education was recommended to provide training sessions for teachers. Gonzales (2020) developed a predictive analytics tool for technical and vocational education and training schools, potentially applicable to statistics courses. Asmat (2020) demonstrated the effectiveness of computer-aided software, specifically Minitab, in improving students' performance in statistics courses. These studies collectively highlight the potential of technology in enhancing the teaching and learning of statistics in the Philippines.

The integration of technology software in statistical analysis has been explored in various studies. Jun (2021) proposed a methodology for integrating and analyzing multiple technologies simultaneously, using patent big data and text mining. Savulescu (2018) developed a computer tool for statistical analysis in the business field, emphasizing the need for high-quality data and well-trained analysts. These studies underscore the potential of technology software in enhancing statistical analysis.

Many studies conducted to determine the impact of statistical software on academic performance of students in statistics in the Philippines. The use of statistical software in the Philippines, such as Excel and SPSS, has been found to significantly impact academic performance and attitude in the field of statistics. Obrial (2020) and Retutas (2021) found that students often struggle with statistical understanding and performance, with the latter study identifying significant differences based on the type of school. However, using localized and context-driven instructional materials has improved students' understanding and appreciation of statistics (Dayta, 2022). These findings suggest a need for further research and development in using statistical software and instructional materials to enhance students' performance and attitude in statistics in the Philippines.

With the recommendations for further research and development in using statistical software and instructional materials to enhance students' performance and attitude in statistics in the Philippines, a potential of software was introduced. JAMOVI, an open-source statistical software, has been introduced as a valuable tool for education in statistics due to its user-friendly interface and integration with R (Majima, 2019). It is highlighted as useful for social scientists, with its core functions, installation process, and module support emphasized (Şahin, 2019). It has been recommended for use in inferential statistics courses for HCI practitioners and researchers (Breuninger, 2023). JAMOVI has also been applied in developing JamVis, a web-based visual analytics framework for exploring and visualizing traffic jams (Rodriguez, 2022). These studies underscore the versatility and potential of JAMOVI as statistical software.

Hence, this study aims to investigate the effectiveness of JAMOVI in the academic performance and attitudes of senior high school students towards learning probability and statistics through. By utilizing technology such as Jamovi's user-friendly interface and comprehensive data analysis capabilities, this research seeks to shed light on the effectiveness of innovative teaching approaches in improving students' attitudes and performance in statistics education.

II. METHODS

This study utilized a quasi-experimental and descriptive-quantitative research design to examine students' attitudes and performance in statistics using JAMOVI software. It involved Grade 11 HUMSS sections from the University of Saint Louis, divided into an experimental group using JAMOVI and a control group with traditional instruction. Data were collected through pretests and posttests to evaluate statistical learning and attitudes were measured using the Students' Attitudes toward Statistics and Technology Scale (SASTSc). The procedure included a literature review, obtaining permissions, administering pretests, providing instruction, conducting posttests, and assessing attitudes. Data analysis used mean, paired-samples t-test, and Independent Samples T-test to determine the effectiveness of JAMOVI and the difference between the attitudes of the respondents before and after using JAMOVI.

Scale used for the Students Pretest and Posttest Scores in Statistics:

Range	Verbal Description
25-30	Excellent
19-24	Very Satisfactory
13-18	Satisfactory
7-12	Fair
0-6	Poor

Scale used for the Students Attitudes toward Statistics and Technology Scale scores:

Range	Verbal Description
1.00-1.49	Highly Negative Attitude
1.50-2.49	Negative Attitude
2.50-3.49	Positive Attitude
3.50-4.00	Highly Positive Attitude

III. RESULTS AND DISCUSSION

Table 1. Pretest Performance of the Respondents in Statistics in the Control and Experimental Group

Scores	Control Group		Experimental Group		Qualitative Description
	N	%	N	%	
25-30	0	0.00	0	0.00	Excellent
19-24	0	0.00	0	0.00	Very Satisfactory
13-18	3	15.00	2	10.00	Satisfactory
7-12	13	65.00	13	65.00	Fair
0-6	4	20.00	5	25.00	Poor
Mean Score	**9.55**	**Fair**	**9.45**	**Fair**	

Table 1 presents the pre-test performance of the respondents in statistics in the control and experimental group based on the 30-item test. The mean scores obtained by the control and experimental groups were 9.55 and 9.45, respectively, both falling under the "Fair" qualitative description. These results indicate that both groups had the same performance in statistics, with majority of students scoring in the second lowest score range. These findings are consistent with research by Smith & Kirby (2020), which indicates that many students struggle to understand statistical concepts and often achieve only average performance without external support. This consistency with prior research highlights the broader context in which the current study is situated. It emphasizes that learning statistics can be inherently challenging for many students and that targeted interventions are often necessary to improve their understanding and performance. Without such support, students are likely to remain at average levels of proficiency in statistics.

Table 2. Posttest Performance of the Respondents in Statistics in the Control and Experimental Group

Scores	Control Group		Experimental Group		Qualitative Description
	N	%	N	%	
25-30	0	0.00	12	60.00	Excellent
19-24	0	0.00	7	35.00	Very Satisfactory
13-18	2	10.00	1	5.00	Satisfactory
7-12	15	75.00	0	0.00	Fair
0-6	3	15.00	0	0.00	Poor
Mean Score	**9.75**	**Fair**	**25.45**	**Excellent**	

Table 2 presents the posttest performance of the respondents in statistics in the control and experimental group. The mean score of the control group is 9.75 which is still under the qualitative description of "Fair". On the other hand, the experimental group who used the JAMOVI had a mean score of 25.45 with a qualitative of qualitative description of "Excellent". These results demonstrate a clear advantage for the experimental group, suggesting that the use of JAMOVI software positively influenced their understanding and mastery of statistical concepts particularly in statistical analysis. This discrepancy highlights the significant impact of JAMOVI software on students' statistical proficiency, aligning with previous research that emphasizes the benefits of integrating technology to enhance learning outcomes (Mok & Kwek, 2020). The findings suggest that JAMOVI Statistical Software is a valuable tool for facilitating hands-on learning experiences and promoting active engagement with statistical concepts. By offering students a platform for interactive data analysis and visualization, the software enables them to explore statistical principles in practical contexts, thereby fostering a deeper understanding of the subject matter. These insights support existing literature that underscores the importance of active learning approaches in statistics education (Ginsberg & Rubin, 2021)

Table 3. Significant Difference between the Pretest Performances of the Respondents in the Control and Experimental Group

Group	Mean Scores	Mean Difference	Df	t-value	p-value	Decision
Control Group	9.55	0.10	19	0.62	0.54	Do not reject Ho
Experimental Group	9.45					

The results form Table 3 indicate that there is no significant difference between the pretest performances of the control and experimental groups in statistics. The mean score of the control group was 9.55, while the mean score of the

experimental group was 9.45. This implies that the difference in the pretest performance between control and experimental group is not statistically significant. Hence, both groups started with a similar level of understanding in statistics before the intervention. These findings align with existing research indicating that many students tend to face challenges in grasping statistical concepts and often perform at average levels without external intervention (Smith & Kirby, 2020).

Table 4. Significant Difference between the Posttest Performances of the Respondents in the Control and Experimental Group

Group	**Mean Scores**	**Mean Difference**	**Df**	**t-value**	**p-value**	**Decision**
Control Group	9.75	-15.70	19	-14.83	0.00	Reject Ho
Experimental Group	25.45					

The results from Table 4 reveal a significant difference between the posttest performances of the control and experimental groups in statistics. The control group had a mean score of 9.75, while the experimental group had a notably higher mean score of 25.45. This indicates that the difference in posttest performance between the control and experimental groups is statistically significant. The significantly higher mean score in the experimental group suggests that the intervention, involving the use of JAMOVI Statistical Software, had a positive impact on students' understanding and mastery of statistical concepts compared to the control group. This discrepancy underscores the transformative effect of JAMOVI software on students' statistical proficiency, aligning with previous research emphasizing the benefits of technology integration in enhancing learning outcomes (Mok & Kwek, 2020). The findings suggest that JAMOVI Statistical Software serves as a valuable tool for facilitating hands-on learning experiences and promoting active engagement with statistical concepts. By providing students with a platform for interactive data analysis and visualization, the software empowers them to explore statistical principles in practical contexts, thereby fostering a deeper understanding of the subject matter. These insights corroborate existing literature highlighting the importance of active learning approaches in statistics education (Ginsberg & Rubin, 2021).

Table 5. Significant Difference between the Pretest and Posttest Performances of the Respondents in the Experimental Group

Experimental Group	**Mean Scores**	**Mean Difference**	**Df**	**t-value**	**p-value**	**Decision**
Pretest	9.45	-16	19	-14.87	0.00	Reject Ho
Posttest	25.45					

Table 5 illustrates a significant difference between the pretest and posttest performances of the experimental group in statistics. Before the intervention, the experimental group had a mean pretest score of 9.45. Following the intervention, which involved the use of JAMOVI Statistical Software, the experimental group's mean posttest scores substantially increased to 25.45. This suggests that the intervention had a significant positive impact on the experimental group's understanding and mastery of statistical concepts. The considerable improvement in mean score from the pretest to the posttest indicates the effectiveness of the intervention in enhancing students' performance in statistics.

Table 7. Attitude of the Experimental Group Before and After the Use of JAMOVI Software in Learning Statistics

Dimensions	**Before the Use of JAMOVI Software**		**After the Use of JAMOVI Software**	
	Mean	**Qualitative Description**	**Mean**	**Qualitative Description**
Statistics cognitive competence	1.54	Highly Negative Attitude	3.33	Positive Attitude
Technology cognitive competence	1.55	Highly Negative Attitude	3.01	Positive Attitude
Learning Statistics with technology	1.82	Highly Negative Attitude	3.36	Positive Attitude
Value	1.72	Highly Negative Attitude	3.05	Positive Attitude
Affect	1.23	Negative Attitude	3.12	Positive Attitude
Mean	**1.57**	**Highly Negative Attitude**	**3.17**	**Positive Attitude**

Table 5 presents the attitude of respondents in the experimental group before and after using JAMOVI Software in learning statistics, as measured across various dimensions. Before the use of JAMOVI Software, respondents expressed

mixed sentiments regarding their statistic's cognitive competence, technology cognitive competence, learning statistics with technology, value perception, and affect towards statistics. The mean scores ranged from 1.23 to 1.82, with qualitative descriptions varying from highly negative to negative. Overall, the respondents have a highly negative attitude towards learning statistics before using JAMOVI software.

However, after the use of JAMOVI Software, significant positive shifts in attitude were observed across all dimensions. The mean scores increased notably, ranging from 3.01 to 3.33, and qualitative descriptions shifted towards positive evaluations. Notably, there was a substantial improvement in statistics cognitive competence, technology cognitive competence, learning statistics with technology, value perception, and affect towards statistics. Respondents reported feeling more confident in their statistics and technology cognitive competencies, finding statistics learning with technology more enjoyable and valuable, and expressing a more positive affect towards statistics overall.

The significant improvements in attitudes after using JAMOVI Software suggest that the intervention positively impacted respondents' perceptions and experiences in learning statistics, contributing to a more positive and confident outlook towards the subject. These results align with previous research highlighting the challenges students may face in adapting to technology in educational settings (Huang et al., 2021). However, following the use of JAMOVI Software, significant positive shifts in attitude were observed across all dimensions. The mean scores notably increased and qualitative descriptions shifted towards positive evaluations. This finding suggests that the intervention positively influenced respondents' perceptions and experiences in learning statistics. Specifically, respondents reported feeling more confident in their statistics and technology cognitive competencies, finding statistics learning with technology more enjoyable and valuable, and expressing a more positive affect towards statistics overall. These results are consistent with studies emphasizing the benefits of technology integration in enhancing students' attitudes towards learning and their overall learning experiences (Wang et al., 2019).

Table 7. Difference Between the Attitude of the Students Towards Learning Statistics Using JAMOVI and Their Performance

Attitude	Mean	df	t-value	p-value	Decision
Before the Use of JAMOVI	1.57	19	-17.6	0.00	Reject Ho
After the Use of JAMOVI	3.17				

Table 17 revealed that there is a significant difference between the students' attitude towards Learning Statistics before and after using JAMOVI Software. Before utilizing JAMVI software, the mean attitude score was 1.57. After the intervention, the mean attitude score was 3.17. This implies that the use of JAMOVI Software had notable impact on the attitude of the respondents towards learning statistics. The substantial increase in the mean attitude score form before to after the intervention indicates the effectiveness of JAMOVI software in fostering more positive outlook and perception among respondents regarding their statistics learning experience.

This finding is aligned with the findings of the study of Ginsberg & Rubin, (2021) that Interactive and experiential learning experiences, such as those facilitated by JAMOVI Software, have been shown to increase student motivation and interest in learning. By leveraging technology to create immersive learning environments, educators can create opportunities for students to develop a deeper understanding of statistical concepts while enjoying the learning process.

V.CONCLUSION AND RECOMMENDATIONS

The study reveals the significant positive impact of JAMOVI Statistical Software on students' performance and attitudes in statistics education. The intervention led to notable improvements in academic performance, with the experimental group achieving higher posttest scores than the control group. Furthermore, the intervention promoted positive changes in students' attitudes towards statistics, increasing their confidence in statistical and technological competencies. Overall, the findings emphasize the potential of technology-based tools like JAMOVI Software to enhance statistics education by offering engaging, hands-on learning experiences and creating a more positive learning environment.

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