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The Effect of the Statistics Analyzer Information System (SAIS) on the Academic Performance of the Grade 10 Learners in Mathematics in San Agustin Integrated School of Libon East District, Division of Albay

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ABSTRACT

This study assessed the effect of the Statistics Analyzer Information System (SAIS) on the academic performance of Grade 10 learners in Mathematics at San Agustin Integrated School, Albay, Philippines. A nonrandomized pretest–posttest control-group design was employed involving 60 purposively selected learners, equally divided into experimental and control groups. A validated 50-item achievement test assessed five statistical competencies, while paired-samples and independent-samples t-tests determined significant performance differences. Initial findings revealed low proficiency in both groups, with pretest performance levels ranging from 33% to 46%. Following one academic quarter of instruction, the experimental group achieved posttest performance levels of 80%–87%, compared with 53%–62% in the control group. Statistically significant improvements were observed within the experimental group, alongside significant posttest differences between groups across all competencies ($p < 0.001$). These findings indicate that SAIS-assisted instruction was associated with improved statistical understanding, computational proficiency, and problem-solving performance. Mathematics teachers are encouraged to integrate SAIS into competency-based instruction, supported by continuous assessment, technical resources, and professional development. The study was limited to one school, a relatively small purposive sample, nonrandom group assignment, and one academic quarter without long-term retention assessment. Nevertheless, it provides empirical evidence supporting technology-enhanced mathematics instruction and institutional decision-making. The findings contribute to educational and digital sustainability by informing the effective integration of instructional technology, consistent with Sustainable Development Goal 4 (Quality Education).

Keywords: *Academic Performance, Digital Learning, Grade 10 Learners, Mathematics Education, Measures of Position, SAIS, Statistical Competencies*

1. INTRODUCTION

Mathematical literacy includes the ability to interpret data, reason quantitatively, and apply statistical concepts to meaningful problems. Yet mathematics learning remains a major concern in the Philippines. In the Programme for International Student Assessment (PISA) 2022, only 16% of participating Filipino students reached at least Level 2 proficiency in mathematics (Organisation for Economic Co-operation and Development [OECD], 2023). Recent research highlights the educational value of authentic data activities and carefully designed visual representations while emphasizing that technology is effective only when aligned with instructional goals (Friedrich et al., 2024; Schoenherr et al., 2024). This study examined the effect of the Statistics Analyzer Information System (SAIS), a web-based tool for computing, visualizing, and interpreting statistical measures, on the academic performance of Grade 10 learners at San Agustin Integrated School, Libon East District, Division of Albay, during School Year 2025–2026. It focused on measures of position—quartiles, deciles, and percentiles—and evaluated whether technology-supported instruction strengthened the competencies assessed through pretests and posttests.

Research Problem

Developing competence in statistics requires more than memorizing formulas. Learners must illustrate distributions, calculate appropriate measures of position, explain their meaning, and use statistical evidence in problem-solving. A systematic review of K–12 statistical and data literacy research identified the importance of authentic problems, real-world datasets, and opportunities for meaningful data interpretation (Friedrich et al., 2024). Another review emphasized the need to strengthen teachers' statistical and data literacy and instructional approaches in mathematics classrooms (Schreiter et al., 2024). Digital learning tools may help learners manipulate and visualize data, but their effects cannot be assumed to be uniformly positive. A meta-analysis of mathematics visualization interventions reported a moderate average benefit for learning while finding no general advantage of digital over non-digital visualization (Schoenherr et al., 2024). Likewise, a meta-analysis involving Indonesian secondary-school students found a moderate positive effect of digital interventions on mathematics achievement, with variation by educational level and topic (Rahma & Nurlaelah, 2024). Research on GeoGebra also indicated that the effectiveness of dynamic visualization depends on implementation characteristics and mathematical content (Zhang et al., 2025). A systematic review of secondary mathematics education further underscored the importance of matching digital resources to learning competencies, pedagogy, and school context (Hernández-Martínez et al., 2025). Accordingly, evidence about educational technology in general does not establish whether SAIS improves Grade 10 learners' mastery of measures of position in a particular Philippine public-school context. The specific research problem was to determine whether learners receiving SAIS-supported mathematics instruction demonstrated improvement from pretest to posttest and obtained different posttest results from a control group taught without SAIS. The inquiry addressed five competencies: illustrating measures of position, calculating specified measures, interpreting their meaning, solving related problems, and applying measures of position and other statistical methods in data analysis. The study also sought to derive instructional pointers from its findings.

Assumptions of the Study

The study assumed that learners' initial competence in the specified statistical skills could be described using pretest scores, that their subsequent performance could be assessed using posttest scores, and that findings from these assessments could inform practical recommendations for mathematics instruction. For meaningful group comparisons, the study

treated baseline comparability and consistent assessment of the same learning competencies as essential design considerations. These assumptions did not predetermine an improvement or a beneficial SAIS effect; the significance of within-group improvement and between-group posttest differences was tested empirically at the 0.05 level.

Objectives of the Study

The study aimed to determine the effect of the Statistics Analyzer Information System (SAIS) on the academic performance of Grade 10 learners in Mathematics at San Agustin Integrated School during the third quarter of School Year 2025–2026. Specifically, it sought to describe the pretest performance of the experimental and control groups in illustrating, calculating, interpreting, solving problems involving, and applying measures of position and related statistical methods; describe their posttest performance after the instructional intervention; determine whether the experimental group showed statistically significant improvement between its pretest and posttest scores; establish whether the experimental and control groups differed significantly in their posttest scores; and formulate evidence-based instructional pointers from the results.

Theoretical or Conceptual Basis

The original study drew on constructivist learning, blended learning, the Technology Acceptance Model, and Cognitive Load Theory. Constructivist principles explain learning through active engagement with statistical problems rather than passive reception of computed answers, while blended instruction describes the combination of teacher-led learning and digital activities. The Technology Acceptance Model offers a rationale for considering the perceived usefulness and usability of SAIS, although technology acceptance was not a measured outcome in this experiment. Recent research on statistical and data literacy supports authentic problem-solving and the use of real-world data as important instructional approaches (Friedrich et al., 2024). The cognitive theory of multimedia learning explains that meaningful learning requires selecting relevant information, organizing it into coherent representations, and integrating it with existing knowledge. Its current formulation emphasizes learners' limited processing capacity and the instructional design of words and visual representations (Mayer, 2024). Applied to SAIS, this perspective suggests that calculations and visualizations should be used to clarify statistical relationships while preserving opportunities for learners to explain procedures and interpret results. Recent synthesis of mathematics visualization research supports the potential benefits of such representations but also cautions against assuming that digital media are inherently superior (Schoenherr et al., 2024). Conceptually, the study followed an input–process–output framework. Inputs consisted of learners' baseline mathematical performance, the targeted competencies in measures of position, and available instructional technology. The process involved teaching the experimental group with SAIS, assessing learning before and after instruction, and comparing outcomes with those of a control group. Outputs comprised measured changes and differences in academic performance and recommendations based on the findings. SAIS was the instructional intervention, while academic performance, operationalized through competency-based test scores, was the outcome. The framework therefore evaluated SAIS through observable learning evidence rather than assuming that system use alone produces achievement.

The study aligns principally with Sustainable Development Goal 4 (SDG 4): Quality Education, particularly the objective of achieving relevant and effective secondary-school learning outcomes. By examining whether a school-based digital tool improves learners' statistical reasoning and mathematics performance, the research provides local evidence that may inform

better instructional decisions and targeted academic support. This emphasis is consistent with the Department of Education's Basic Education Development Plan 2030, which prioritizes improvements in learning quality and education-system performance (Department of Education, 2022). The study also addresses educational, digital, and institutional sustainability in a limited and practical sense. An evidence-based decision on SAIS could help teachers select appropriate learning resources, monitor achievement, and refine instruction over time. However, these potential contributions depend on adequate access, teacher preparation, accessibility, and continued pedagogical value. The United Nations Educational, Scientific and Cultural Organization (UNESCO, 2023) cautioned that educational technology should be adopted on evidence of its appropriateness, equity, and sustainability rather than on technological novelty alone. Consequently, the study's contribution to SDG 4 lies in testing an instructional innovation and informing decisions about its responsible use, not in demonstrating broader sustainability impacts beyond those measured.

2. METHODOLOGY

Research Design

The study employed a pretest–posttest control-group design, described in the original manuscript as true-experimental, to examine the effectiveness of SAIS in improving learners' statistical competencies. Sixty Grade 10 learners were divided into an experimental group that received SAIS-assisted instruction and a control group that underwent conventional mathematics instruction. Both groups completed a pretest to establish baseline performance and a posttest to measure learning outcomes after an intervention lasting one academic quarter. The design enabled the researcher to assess improvements within the experimental group and differences in performance between the two groups. However, the use of purposively selected intact classes and nonrandom group assignment distinguishes the actual procedure from a fully randomized experiment.

Research Locale or Study Setting

The study was conducted at San Agustin Integrated School, a public educational institution located in San Agustin, Libon, Albay, Philippines, under the Libon East District, Division of Albay. The school implements the K to 12 Basic Education Curriculum and provides mathematics instruction to junior high school learners. The research focused on Grade 10 Mathematics during School Year 2025–2026, particularly the competencies involving quartiles, deciles, percentiles, and the application of statistical methods in data interpretation and problem-solving.

Participants or Data Sources

The participants comprised 60 Grade 10 learners selected through purposive sampling from intact classes. Thirty learners were assigned to the experimental group, while the remaining 30 constituted the control group. Participant selection considered the availability of computers or tablets, internet connectivity for optional system updates or synchronization, and the willingness of school personnel to participate. The groups were matched as closely as possible in academic performance, class size, and teacher experience. Learners' demographic and socioeconomic characteristics, including sex, age, family monthly income, parental educational attainment, parental occupation, and dwelling conditions, were also examined to determine group comparability before the intervention.

Research Instruments or Materials

The primary research instruments consisted of a researcher-developed 50-item mathematics achievement test administered as a pretest and posttest, instructional lesson plans, and the

Statistics Analyzer Information System (SAIS). The achievement test covered five competencies, with 10 items each on calculating measures of position, illustrating quartiles, deciles, and percentiles, interpreting measures of position, solving related problems, and applying statistical methods in data analysis. SAIS served as the digital instructional intervention, providing computational, visualization, and interpretation functions for statistical concepts. The study also described the use of a learner feedback survey to assess engagement and perceptions of the learning experience. The achievement test underwent content validation by the research adviser, panel members, and selected teachers. Item analysis examined difficulty and discrimination indices using the upper and lower 33% of test scores. Following evaluation, 37 items were retained, 12 were revised, and one was replaced. Test reliability was assessed through the split-half method, using Pearson's product–moment correlation and the Spearman–Brown formula, which yielded a reliability coefficient of 0.82, indicating high reliability.

Data Gathering Procedure

The researcher initially secured permission from the Public Schools District Supervisor of Libon East District and the school head of San Agustin Integrated School. Following instrument development, validation, and revision, the achievement test was administered to both groups to determine their initial competencies in measures of position. The experimental group subsequently received technology-assisted instruction using SAIS to facilitate statistical computation, data visualization, interpretation, and problem-solving, while the control group continued with conventional classroom instruction. The intervention covered one academic quarter. After its implementation, the same assessed competencies were evaluated through a posttest administered to both groups. Learners' assessment results and relevant profile information were collected, organized, tabulated, and verified for statistical analysis. The resulting data provided the basis for determining learning improvements, comparing group performance, and formulating instructional recommendations.

Data Analysis

The collected data were analyzed using descriptive and inferential statistics. Frequency counts, percentages, means, and standard deviations were used to summarize learners' profiles and assessment performance. The chi-square test of independence determined the comparability of the experimental and control groups based on selected demographic, socioeconomic, and baseline performance characteristics. Difficulty and discrimination indices were computed to evaluate test items, while Pearson's product–moment correlation and the Spearman–Brown formula were used to assess instrument reliability. A paired-samples t-test determined whether the experimental group demonstrated significant improvement between its pretest and posttest scores. An independent-samples t-test assessed differences in posttest performance between the experimental and control groups. All inferential tests were evaluated at the 0.05 level of significance. The statistical findings served as the basis for assessing SAIS effectiveness and developing recommendations for improving mathematics instruction.

Ethical Consideration

The study observed ethical procedures concerning informed consent, voluntary participation, confidentiality, and equitable treatment of participants. Permission to conduct the research was obtained from the appropriate district and school authorities before administering the instruments. Learners participated under the established research procedures, while their responses and assessment results were handled confidentially. Both groups received mathematics instruction aligned with the prescribed curriculum, with SAIS serving as the

instructional intervention for the experimental group. These measures were intended to protect participants' rights and support the responsible collection and analysis of educational data.

3. RESULTS AND DISCUSSION

3.1 Academic Performance of Grade 10 Learners in Mathematics

3.1.1 Pretest Performance of the Experimental and Control Groups

The pretest results revealed that both the experimental and control groups demonstrated low initial performance across the five statistical competencies. The experimental group obtained mean scores of 4.30 (43%) in illustrating measures of position, 4.60 (46%) in calculating specified measures, 3.90 (39%) in interpreting measures, 3.70 (37%) in solving problems, and 3.50 (35%) in applying statistical methods. Correspondingly, the control group recorded mean scores of 4.10 (41%), 4.40 (44%), 3.70 (37%), 3.50 (35%), and 3.30 (33%). All competency scores were classified as Needs Improvement, indicating limited initial mastery of quartiles, deciles, percentiles, and related statistical applications. The relatively close pretest scores also indicated comparable baseline performance between the two groups. These findings suggest that the learners initially experienced difficulties in understanding and applying statistical concepts, particularly in interpreting data and solving problems involving measures of position. Similar challenges were identified by Balkaya and Kurt (2023), who examined middle school students' statistical reasoning and demonstrated the importance of statistical modeling activities in developing an understanding of distributions. Their findings emphasize the value of learning experiences that connect statistical representations with meaningful interpretations, supporting the instructional rationale for evaluating SAIS as a supplementary mathematics learning tool.

3.1.2 Posttest Performance Following the Implementation of SAIS

The posttest results demonstrated higher academic performance among learners exposed to SAIS compared with those who received conventional instruction. The experimental group obtained mean scores of 8.70 (87%) in illustrating measures of position, 8.50 (85%) in calculating specified measures, 8.20 (82%) in interpreting measures, 8.00 (80%) in solving problems, and 8.10 (81%) in applying statistical methods. All competencies were classified as Very Satisfactory. In contrast, the control group registered corresponding mean scores of 6.20 (62%), 6.00 (60%), 5.80 (58%), 5.50 (55%), and 5.30 (53%), all categorized as Needs Improvement. The experimental group consistently demonstrated higher posttest performance across the five competencies.

The findings indicate that learners exposed to SAIS achieved stronger mastery of statistical concepts than those receiving conventional instruction. This result is consistent with Batur and Çakıroğlu (2023), who reported significant improvements in high school students' aggregate statistical reasoning through digitally supported instructional activities. The findings also agree with Schoenherr et al. (2024), whose meta-analysis identified positive effects of visualization-based interventions on mathematics learning. Together, these studies support the educational potential of appropriately designed digital tools for strengthening learners' understanding and application of mathematical concepts.

3.2 Statistical Significance of the SAIS Intervention

3.2.1 Significant Improvement Between the Pretest and Posttest Scores of the Experimental Group

The paired-samples t-test revealed statistically significant improvements in all five competencies following the implementation of SAIS. Mean score increases were 4.40 for illustrating measures of position, 3.90 for calculating specified measures, 4.30 for interpreting measures, 4.30 for solving problems, and 4.60 for applying statistical methods. The corresponding computed t-values were 10.85, 10.39, 9.78, 9.89, and 10.21, respectively, with all reported probability values below 0.001. These results exceeded the critical t-value of 2.045 at 29 degrees of freedom and the 0.05 significance level. Consequently, the null hypothesis stating that no significant improvement existed between the experimental group's pretest and posttest scores was rejected. The significant improvements suggest that SAIS-supported instruction was associated with substantial development in learners' computational, interpretative, and problem-solving competencies. Rao et al. (2023) emphasized that structured learning activities connecting data and visual representations can develop statistical reasoning, particularly when learners receive appropriate instructional guidance. Similarly, Rahma and Nurlaelah (2024) reported an overall positive effect of digital technology interventions on secondary school students' mathematics achievement. These findings provide empirical support for the observed improvement among learners exposed to SAIS, particularly its intended role in facilitating statistical computation, visualization, and interpretation.
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3.2.2 Significant Difference Between the Posttest Scores of the Experimental and Control Groups

The independent-samples t-test established statistically significant differences between the posttest scores of the experimental and control groups across all five competencies. The computed t-values were 8.17 for illustrating measures of position, 8.02 for calculating specified measures, 7.90 for interpreting measures, 8.45 for solving problems, and 9.60 for applying statistical methods. The corresponding mean differences were 2.50, 2.50, 2.40, 2.50, and 2.80 points, respectively. All reported probability values were below 0.001, exceeding the critical t-value of 2.001 at 58 degrees of freedom and the 0.05 significance level. The null hypothesis stating that no significant difference existed between the posttest scores of the experimental and control groups was therefore rejected. These findings indicate that the experimental group achieved significantly higher mathematics performance than the control group following SAIS-assisted instruction. The results suggest that integrating the system into statistical learning activities may have contributed to stronger understanding and application of measures of position. Nevertheless, Zhao et al. (2023) demonstrated that interactive statistical visualizations do not automatically produce better learning outcomes than static representations, highlighting the importance of appropriate instructional design. Accordingly, the present findings support the effectiveness of SAIS within the conditions of this study rather than establishing that digital tools are universally superior to conventional instruction.

3.3 Instructional Implications and Recommendations Derived from the Findings

The findings provided the basis for instructional recommendations involving learners, teachers, parents, school heads, and other educational stakeholders. Learners were encouraged to use

SAIS actively, practice statistical problem-solving, and strengthen their interpretation and analytical skills. Teachers were advised to integrate technology-supported activities into mathematics instruction, provide regular assessments and timely feedback, and participate in professional development programs. Parents were encouraged to support learners' academic progress and technology-assisted learning at home, while school heads and stakeholders were advised to provide digital resources, technical support, teacher training, and sustained monitoring of technology-based instruction. These recommendations were developed from the observed differences in academic performance and the significant improvements demonstrated by the experimental group. The proposed instructional measures emphasize the importance of combining digital resources with continuous assessment, instructional guidance, and institutional support. Maskos et al. (2025), in their systematic review of formative assessment in mathematics education, identified the potential of computer-based assessment and interactive learning environments to support student achievement, while emphasizing the influence of implementation conditions and assessment practices. These findings reinforce the value of monitoring learners' progress, providing targeted feedback, and ensuring that technology-assisted instruction remains aligned with mathematical competencies. Consequently, the findings of the present study provide a basis for strengthening the instructional implementation of SAIS and supporting evidence-based improvements in mathematics education.

4. CONCLUSIONS AND RECOMMENDATIONS

The study demonstrated that the Statistics Analyzer Information System (SAIS) was associated with significant improvements in the academic performance of Grade 10 learners in Mathematics at San Agustin Integrated School, Libon East District, Division of Albay. Both experimental and control groups initially exhibited low proficiency in measures of position, particularly in statistical interpretation, problem-solving, and data analysis. Following the intervention, learners exposed to SAIS achieved consistently higher posttest scores than those receiving conventional instruction, with statistically significant improvements across all five assessed competencies. These findings indicate that SAIS-assisted instruction can support learners' understanding, computation, interpretation, and application of statistical concepts. Although both groups began with comparable levels of performance, the experimental group demonstrated stronger learning outcomes after the intervention. Overall, the study provides school-based empirical evidence supporting the integration of SAIS as a supplementary instructional tool for strengthening statistical competencies and improving mathematics learning outcomes.

Mathematics teachers are encouraged to integrate SAIS into classroom instruction, particularly when teaching quartiles, deciles, percentiles, and statistical problem-solving. Instructional activities should prioritize data interpretation, analytical reasoning, and practical applications, considering the learners' initial difficulties in these competencies. Teachers should regularly assess learners' progress, provide timely feedback, and align SAIS-based activities with prescribed mathematics learning competencies. School administrators should support the sustained implementation of SAIS through adequate computers, internet connectivity, technical assistance, and professional development programs for teachers. Learners should actively participate in technology-assisted activities and practice statistical computations and interpretations to reinforce their understanding. Parents and other stakeholders should support learners' academic progress and contribute to initiatives that strengthen technology-enhanced instruction. Future researchers are encouraged to replicate the study across different grade

levels, schools, and mathematical topics, compare SAIS with other digital learning tools, and examine its long-term effects on learners' retention and academic performance.

The study was limited to 60 Grade 10 learners from a single public school in Libon East District, Division of Albay, during School Year 2025–2026. Participants were selected through purposive sampling, and intact classes were assigned to experimental and control groups without randomization, potentially limiting causal interpretation and generalizability. The intervention covered one academic quarter and focused exclusively on measures of position and related statistical competencies. Academic performance was assessed through researcher-developed pretests and posttests, while long-term retention was not evaluated. These limitations suggest the need for broader samples, additional school settings, randomized designs where feasible, and extended assessment periods.

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