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The effectiveness of statistical learning tasks based on Excel software in developing statistical thinking skills related to the labor market among students of the Applied College

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Research Article

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Abstract

Background/purpose. This study addresses the lack of statistical thinking skills among Applied College students, a key requirement for professional success. Traditional statistics education focuses on procedural and computational methods rather than conceptual understanding, leading to misconceptions and difficulties in data organization, summarization, and interpretation. The research aligns with Umm Al-Qura University's Program Transformation Project, emphasizing workforce readiness by enhancing statistics courses. The study's primary goal was to design and implement Excel-based statistical learning tasks to improve students' statistical thinking skills, particularly in the Banking and Finance diploma program. The study aimed to equip students with essential data-handling skills for professional environments by integrating practical applications.

Materials/methods. This study utilized a mixed-methods approach, combining qualitative and quantitative techniques. The qualitative aspect focused on designing Excel-based statistical learning tasks and identifying essential statistical thinking skills, while the quantitative component employed a quasi-experimental design to evaluate task effectiveness.

Results. The study demonstrated a significant improvement in statistical thinking skills among the experimental group using Excel-based tasks. It confirmed their effectiveness in developing key skills. It emphasized their importance in the job market, particularly for banking and finance diploma students, highlighting their role in enhancing future professional competencies.

Conclusion. The study concluded that Excel-based statistical learning tasks effectively develop students' statistical thinking skills. These skills are essential for success in the job market, particularly for students in banking and finance diploma programs.

1. Introduction

Preparing for the labor market has become an essential requirement, and all available resources in the Kingdom have been directed to address this gap and equip the labor market with qualified individuals who can achieve professional excellence. This aspect is considered one of the vital dimensions outlined in the Kingdom's Vision through various initiatives, such as the Vision's goals and directions and the Human Capabilities Program (Human Capacity Development Program, 2021).

Therefore, the College of Applied Sciences has worked on updating all of its programs and introducing specialized programs to meet the labor market's requirements and reduce job mismatches in the labor market. This update is part of the development framework being implemented by Umm Al-Qura University and aligns with the Ministry's direction towards global competitiveness.

Statistics courses are considered essential service courses (Harris, 2023). Statistics courses are crucial for first-year students, equipping them with real-world application skills and improving their statistical literacy (Ruiz et al., 2024). These courses foster critical thinking abilities necessary for interpreting media and research findings. They help close the quantitative proficiency gap and tackle diverse skill levels and negative attitudes toward mathematics. Additionally, they provide fundamental skills for data analysis and informed decision-making (Baligar et al., 2017; Farnsworth, 2022).

However, the state of statistical thinking skills among students is surrounded by many issues, with their levels ranging from medium to low (Rahmah & Setianingsih, 2020; Kesumawati, 2020). In the same context, the results of the study (Sulistyani, 2019) indicate further problems in statistical thinking, such as conceptual errors where students struggle to read statistical tables or interpret the results of questions, procedural issues related to mathematical calculations in statistics, and interpretive problems in understanding the results of computations. Therefore, focusing on developing statistical thinking for diploma students is an essential requirement for engaging in the labor market and the ability to work with data in the professional environment, particularly for students pursuing diplomas in banking and finance.

Universities and colleges face significant pressure to ensure the success of their graduates in the labor market. As such, they must take proactive measures to develop the skills demanded by the labor market. A review of the literature analyzing the labor market's need for statistical skills revealed three studies (Ciabattari et al., 2018; Hershbein et al., 2018; Lee et al., 2018). The study by (Ciabattari et al., 2018) showed that the labor market requires graduates to work with numbers and understand statistics, including technical skills, organizational skills, quantitative analysis skills, and technical proficiency. Meanwhile, (Hershbein et al., 2018) found that the most significant increase in demand was for cognitive skills such as mathematical and statistical skills. The study by (Lee et al., 2018) classified the technical statistical skills the labor market needs from specialists in finance and business into six categories: data entry and organization, statistical calculations, graphs, logic, tables, financial calculations, and scenario analysis.

In contrast, the literature on statistics education has presented several classifications of statistical thinking skills. For example, studies by (Chan et al., 2016 Jones et al., 2000; Mooney, 2002) classified statistical thinking skills into four categories: describing data, organizing and summarizing data, representing data, and analyzing and interpreting data. The study (Watson & Callingham, 2003) proposed a threefold framework for statistical thinking skills: understanding terminology, grasping the basic concepts within their context, and using critical thinking. (DelMas, 2002) framed statistical thinking skills through comparisons between statistical literacy and statistical inference concepts, identifying skills such as application, criticism, evaluation, and generalization. Similarly, the study (Garfield, 2003) viewed statistical thinking skills through the lenses of questioning and justification.

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The use of lecture-based teaching predominantly characterizes the university education environment. The study's results (Wahab et al., 2018) indicated that this method restricts students' abilities and makes them less exploratory in statistics courses. Furthermore, this approach has exacerbated several issues in teaching statistics, such as focusing on procedural and computational aspects rather than developing conceptual understanding (Shaughnessy, 2007) and the inability to apply statistics in daily life (Verhoeven, 2006). Additionally, it has not addressed the mathematical-statistical knowledge difficulties required for statistical calculations, such as fractions, decimal fractions, and algebraic formulas, which contradicts the learning of statistical content (Garfield & Ben-Zvi, 2004).

Therefore, the study aimed to design statistical tasks by analyzing a set of features from task design frameworks to identify the components of learning tasks, as outlined in the following table.

Table 1. Comparison of Task Features

	Task Features			
Studies	Context	Purpose of the Task	Cognitive Demand / Task Complexity	Content
(Wijaya et al., 2015)	X	X	X	X
(Gracin, 2018)	X		X	
(Paredes et al., 2020)	X		X	
(Gün & Taş, 2021)		X	X	
(Radmehr, 2023)	X	X	X	

The comparisons between these five studies in the table identified the most recurring components, as repetitions indicate agreement on the standard features among these frameworks. These components are as follows:

Context: Context is considered important in designing educational tasks. It is defined as a situation or event within the task, often derived from real-life situations or hypothetical scenarios (Vos, 2020). Most literature agrees on the importance of contextual tasks (Gracin, 2018; Paredes et al., 2020) because they provide opportunities for engagement and motivation for learning (Widjaja, 2013). They also play a significant role in achieving and increasing mathematical understanding (Agustan, 2016; Fatimah et al., 2020).

Task Complexity / Cognitive Demand: Cognitive demand is one of the essential dimensions required to create strong mathematics classrooms (Schoenfeld, 2019). Therefore, task designers need to carefully consider how to intellectually challenge students and pay close attention to inclusivity when increasing the complexity of tasks (Radmehr, 2023). Cognitive demand is "the cognitive processes that students engage in while working on the task" (Stein et al., 1996). It is viewed as a range of thinking processes, from simplicity to complexity (Paredes et al., 2020). The studies have various perspectives regarding the type of cognitive demand; some view it as cognitive processes ranging from low to high, as in (Stein et al., 1996), who distinguished between low and high cognitive demand levels. Similarly, (Wijaya et al., 2015). used the cognitive processes from the PISA study, and (Stein et al., 1996) used the cognitive domains from international TIMSS studies. Previous studies have varied interpretations of cognitive demand and task complexity but agree that tasks range from low to high. In this study, the levels of task complexity were considered by integrating statistical thinking skills in literature and the job market, as reflected in the study procedures.

Excel in statistical work requires job market skills, as indicated by the study of (Lee et al., 2018), which noted that most job advertisements for finance and business professionals require proficiency in Excel. Excel helps build confidence and foster positive attitudes when used to solve mathematical problems by designing meaningful and practical exercises (Shi, 2005). Additionally, Excel assists

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mathematics teachers in teaching graphing (George & Kumah, 2021). It also enables the application of central tendency measures and dispersion measures (Mahato, 2023). The study by (Nur & Rambe, 2023) highlighted the effectiveness of using Excel in improving academic achievement in learning statistics for seventh-grade students, further adding that learning through Excel significantly affects students. The study (George & Kumah, 2021) concluded that Excel effectively enhances students' performance in learning graphs.

Metacognition plays an important role in the success of classroom practices (Artzt & Armour-Thomas, 2001). The study's results (Wilson & Bai, 2010) indicated that teachers' understanding of Metacognition and its use in teaching has positive implications for students' problem-solving abilities in mathematics. The study (Perry et al., 2019) found a positive relationship between Metacognition and students' outcomes. The importance of Metacognition lies in its cognitive structure, which relies on unleashing self-regulatory abilities, as it allows teachers to shift the responsibility of learning from the teacher to the students. It challenges students whenever teachers use it as scaffolding to improve and develop the challenge for students (Ghasempour et al., 2013). Moreover, metacognitive interventions are highly beneficial for both typical learners and low-performing students (Schneider & Artelt, 2010).

Based on the importance reflected by metacognitive interventions, the interactive roles of the teacher and the learner were distributed into three phases: timing of support, method of support, and clarification of support. Table 2 illustrates the interactive roles between the teacher and students.

Table 2. The Interactive Roles Between Teacher and Learner

Timing of Support	Support Methods	Explanation	Source
Before the Task	- Organizing students -Task preparation	-Organizing students cooperatively - Introducing concepts or skills for task engagement	(Parrish & Bryd, 2022)
During the Task	Exploration	- Providing students with an opportunity to explore the task and work on it - Allowing sufficient time for individual or collaborative group work	(Shilo & Kramarski, 2019)
	Monitoring and Questioning	- Supporting student engagement by moving around and monitoring their work - Asking conceptual questions such as: What method will you use to solve this? Should you refer to statistical concepts? How will you know your answer is correct?	(Zepeda et al., 2019)
After the Task	Building Consensus on Task Understanding	- Selecting student solutions and provoking thought on them - Connecting students' task solutions with task objectives	(Ducharme et al., 2022)

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In the context of developing statistical thinking skills, many studies have focused on enhancing these skills, such as the studies (Abdul Hamid, 2006;; Ali,2011;; Al-Rawahy, 2017;; Musa, 2022;; Altaylar & Kazak, 2021). The study (Abdul Hamid, 2006) highlighted the effectiveness of using a hands-on experimental approach in improving achievement, statistical thinking, and retention of statistical learning among second-year preparatory students. Similarly, the study (Ali,2011) concluded that using the constructivist learning model effectively developed statistical thinking skills, achievement, and retention of statistical learning among students at the College of Education. The study (Al-Rawahy, 2017) examined the impact of using WebQuest on developing statistical thinking skills among tenth-grade students in Oman. Furthermore, the study (Musa, 2022) investigated the impact of problem-solving strategies on enhancing statistical thinking skills among sixth-grade primary school students. Lastly, the study (Altaylar & Kazak, 2021)discussed the effectiveness of real-world mathematics instruction in developing statistical thinking levels. The present study aligns with earlier research regarding the significance of statistical thinking skills. It sets itself apart by creating tasks for statistical learning using the Excel program and developing statistical thinking skills that meet labor market demands.

2. Study Problem

Statistical thinking is considered an essential skill for engaging students of the Applied College in professional work. In response, Umm Al-Qura University has focused on labor market skills through its extensive program transformation project, which began in 2021, aiming to equip students with these skills, including service courses, with statistics courses at the forefront. A review of the state of statistics education indicates limited teaching methods and strategies, as noted in studies such as (Ciabattari et al., 2018), which found challenges in teaching statistics, such as a focus on procedural and computational aspects rather than developing conceptual understanding, and the lack of application of statistical knowledge to real-world problems, with an emphasis on theoretical aspects (Garfield et al., 2002). (Garfield & Ben-Zvi, 2004)This has resulted in misconceptions regarding students' skills, with recent studies indicating that the average errors made by students on statistical thinking skills tests are estimated at 66% (Ariwinanda et al., 2022) in organizing and summarizing data through incorrect application and lack of understanding of measures of central tendency and the ability to select appropriate graphs (Saidi & Siew, 2019). A study (Meitrilova & Putri, 2020)attributed these errors to several factors, including students' weak understanding of averages, problems in reading the question information, issues in analyzing the question, and difficulties finding averages through graphical representations (Chan et al., 2016). Additionally, university students often struggle with interpreting averages and determining the nature of the relationship between the mean, median, and mode (Rosidah & Ikram, 2021). Therefore, studies have recommended adopting methods and ideas to develop statistical thinking skills, such as those suggested by (Safarini, 2019).

2.1. Study Objectives

The study aimed to design a set of statistical learning tasks based on Excel software, develop a list of statistical thinking skills related to the labor market needs for students of the Banking and Finance Diploma program, and examine the effectiveness of Excel-based statistical learning tasks in developing statistical thinking skills related to the labor market requirements.

2.2. Study Questions

The study aimed to answer the following questions:

1) What constitutes the essence of statistical learning tasks based on Excel?
2) What statistical thinking skills are pertinent in the job market?

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3) To what extent are statistical learning tasks based on Excel effective in fostering statistical thinking skills pertinent to the labor market among students in applied colleges?

4) Hypothesis: There are no statistically significant differences at the significance level (α=0.05) between the average scores of the experimental group, who engage in the study through statistical learning tasks utilizing Excel, and the average scores of the control group, who employ the traditional method, on the statistical thinking skills assessment.

2.3. Importance of the study

The study presented a set of Excel-based statistical learning tasks framed within professional contexts that simulate professional modeling. These tasks also contribute to improving statistical thinking skills. Designing and implementing statistical learning tasks helps faculty members teaching statistics courses construct and implement such tasks based on practical and purposeful practices. Additionally, the statistical thinking skills generated by the study contribute to raising awareness and attention to these skills when teaching statistics.

3. Materials and Methods

3.1. Study Method

A qualitative, thematic approach was used to design the statistical learning tasks and develop statistical thinking skills related to the labor market. An experimental method, specifically a quasi-experimental design, was employed to examine the effectiveness of the statistical learning tasks in developing statistical thinking skills related to the labor market. The two groups were divided into an experimental group and a control group. A pre-test on statistical thinking skills related to the labor market was administered to both groups. The experimental group received the treatment, while the control group followed the traditional teaching method. After the experiment, a post-test on statistical thinking skills was administered, and the statistical analysis results of both groups were compared.

3.2. Study Population and Sample

The study population comprises 140 students enrolled in the Banking and Finance Diploma program. The study sample includes 38 students representing two sections of the Principles of Statistics course, which accounts for 27% of the study population. The two sections were divided into an experimental group, which is Section (1) with 19 students, and a control group, which is Section (2) with 19 students. They were selected through random sampling.

3.3. Study Instrument

The statistical skills were analyzed and linked according to the global and local labor market analysis and connected to statistical thinking skills in the literature of statistical education through thematic analysis. The stages of thematic analysis (Nowell, 2017) were used to align theoretical frameworks and develop categories across these frameworks through the following steps: (a) repeatedly reading the data, (b) grouping similar codes through comparison, (c) reviewing the themes and categories, (d) labeling the themes according to their similar characteristics. Table 3 illustrates the method of analyzing and linking statistical skills.

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Table 3. Statistical skills

Skills	Indicators	Items
Statistical Knowledge	- Reading statistical information - Awareness of the context of information in tables and graphs	4
Statistical Calculations	- Calculating mean, median, mode, and standard deviation	5
Handling Tables and Graphs	- Creating and organizing data in tables - Identifying the appropriate type of graph - Representing data in graphs	5
Statistical Inference	- Comparing data - Explaining statistical processes - Evaluating data - Justifying conclusions	4

The objective of the Statistical Thinking Skills Test related to the labor market is to assess the level of students in the Banking and Finance Diploma program who are studying the Principles of Statistics course in terms of their statistical thinking skills, which include statistical knowledge, statistical calculations, handling tables and graphs, and statistical inference.

3.4. Reliability and Validity of the Test

The validity of the Statistical Thinking Skills Test was verified by presenting it to a panel of experts in mathematics education. The experts were asked to provide their opinions on the tool's linguistic, cognitive, and relational appropriateness and its ease of understanding and clarity. The experts' opinions showed a consensus of 75.4%, indicating good agreement. Based on this, the final version of the test was approved.

To assess the reliability of the test, it was administered to a pilot sample of 15 students from the Banking and Finance Diploma program outside the study sample. The "Cronbach's Alpha" was used for each of the primary statistical thinking skills included in the test and the entire test. Table 4 presents the reliability coefficients.

Table 4. presents the reliability coefficients

Skills	Number of Test Items	Reliability Coefficient
Statistical Knowledge	4	0.73
Statistical Calculations	5	0.97
Handling Tables and Graphs	5	0.95
Statistical Inference	4	0.93
Entire Test	18	0.96

Table 4 shows that the overall reliability coefficient was approximately 0.96. The reliability coefficient for the skill of statistical knowledge was 0.73; for statistical calculations, it was 0.97; for handling tables and graphs, it was 0.95; and for statistical inference, it was 0.93. This indicates that the test exhibits an acceptable level of reliability, making it dependable for the study's experimental application.

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3.5. Equivalence of Study Groups

Before the intervention, the equivalence of the scores of the experimental and control groups in statistical thinking skills was verified. The Mann-Whitney U test for independent samples was used to identify significant differences between the mean ranks of the experimental and control groups. Table 5 presents the results of the pre-test application between the study groups.

Table 5. Results of the pre-test application between the study groups

Field	Group	N	Mean Ranks	Sum of Ranks	Mann-Whitney U	Significance Level
Knowledge	Experimental	19	19.5	370.5	180.5	1.000
	Control	19	19.5	370.5		
Calculation	Experimental	19	19.79	379.5	171.5	0.781
	Control	19	19.03	361.5		
Handling	Experimental	19	19.71	374.5	176.5	0.897
	Control	19	19.29	366.5		
Inference	Experimental	19	19.53	371	180	0.985
	Control	19	19.47	370		
Overall Test	Experimental	19	19.92	378.50	172.5	0.814
	Control	19	19.08	362.50		

It can be seen from Table 5 that there are no statistically significant differences at the 0.05 significance level between the results of the experimental and control groups on the pre-test of statistical thinking skills. The significance level for the overall test was 0.814, which is greater than 0.05, indicating a non-significant result. The significance levels for the statistical skills ranged from 0.781 to 0.985, which are also above 0.05, indicating no statistical significance. These results reflect indicators of equivalence between the two groups before the intervention was applied. The resemblance observed in pre-test scores can be ascribed to multiple factors, including the common prior knowledge possessed by both groups and the impartiality of the test design, which did not advantage one group over the other. Furthermore, the congruence of test items with the curriculum to which both groups had been exposed played a significant role in facilitating comparable performance, thereby indicating an equivalence in statistical thinking skills prior to the implementation of the experimental intervention.

4. Results

4.1. To answer the first question, "What is the role of statistical learning tasks based on Excel?"

the study concluded that the model of statistical learning tasks based on Excel consists of the following components:

Task Context: This refers to the task's ability to reflect the professional world of students in the Banking and Finance Diploma program, incorporating professional information into the tasks.

Cognitive Demand: The tasks include statistical thinking skills that are linked to the labor market, such as statistical knowledge, statistical calculations, working with graphs and tables, and statistical inference.

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Task Environment: The tasks are executed using the Excel program, which provides a platform for conducting various statistical learning activities.

4.2. To answer the second question, "What are the statistical thinking skills related to the labor market?"

The statistical skills were analyzed and linked based on global and local labor market analyses and connected to statistical thinking skills in the literature of statistical education through thematic analysis. Four key statistical thinking skills were identified:

- Statistical Knowledge
- Statistical Calculations
- Working with Tables and Graphs
- Statistical Inference

4.3. To answer the third research question, "What is the effectiveness of statistical learning tasks based on Excel in developing statistical thinking skills related to the labor market among students of the Applied College?"

The null hypothesis was tested as follows: There are no statistically significant differences at the ($\alpha = 0.05$) level between the mean scores of the experimental group, which studied using statistical learning tasks based on Excel, and the mean scores of the control group, which studied using the traditional method, in the statistical thinking skills test.

The conditions for the independent samples t-test were verified, including the normality of the distribution through the Kolmogorov-Smirnov test and the homogeneity of variance through Levine's test. The results were as follows:

Table 6. Results of the test of moderation and homogeneity of variance in the post-test

Field	Group	N	The Kolmogorov-Smirnov test	Statistical significance	Levin Test	Significance Level
Knowledge	Experimental	19	0.511	0.000	39.71	0.000
	Control	19				
Calculation	Experimental	19	0.509	0.000	35.75	0.000
	Control	19				
Handling	Experimental	19	0.343	0.000	49.55	0.000
	Control	19				
Inference	Experimental	19	0.283	0.000	3.05	0.089
	Control	19				
Overall Test	Experimental	19	0.143	0.049	8.22	0.007
	Control	19				

Table 6 shows that the assumptions of normality are not met, as the significance levels are less than 0.05. Additionally, the assumption of homogeneity of variances is not satisfied, as the significance levels resulting from Levin's test for each skill, combined and individually, are all less than

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0.05. Therefore, the non-parametric equivalent test, the Mann-Whitney test, was employed. Table 7 presents the results of the Mann-Whitney test for the experimental and control groups in the post-test.

Table 7. Mann-Whitney test results for the two study groups in the post-application

Skills	Group	N	Mean Ranks	Mann-Whitney U	Significance Level	Value of Z	Effect size
Knowledge	Experimental	19	28.68	6.000	0.000	-5.13	1.18
	Control	19	10.32		Significant		High
Calculation	Experimental	19	22	133	0.019	-2.36	0.54
	Control	19	17		Significant		High
Handling	Experimental	19	22	133	0.019	-2.36	0.54
	Control	19	17		Significant		High
Inference	Experimental	19	23.66	101.5	0.015	-2.44	0.56
	Control	19	15.34		Significant		High
Overall Test	Experimental	19	27.74	24	0.000	-4.84	1.11
	Control	19	11.26		Significant		High

Additionally, the table shows statistically significant differences between the mean ranks of the experimental and control groups for each statistical thinking skill in the post-test. The Mann-Whitney U test revealed statistically significant differences between the mean ranks of the experimental and control groups in the skill of statistical knowledge, with differences favoring the experimental group. The Mann-Whitney U test value was (133) with statistical significance (0.019) and a large effect size of (0.54). Similarly, statistically significant differences appeared between the mean ranks of the experimental and control groups in the skill of statistical calculations, with differences in favor of the experimental group. The Mann-Whitney U test value was (133) with statistical significance (0.019) and a large effect size of (0.54). In the same context, the experimental group showed a statistically significant superiority over the control group in the skill of handling statistical charts and tables, with a Mann-Whitney U test value of (101.5), statistical significance (0.015), and a large effect size of (0.56). Additionally, the experimental group outperformed the control group in the skill of inference, with a Mann-Whitney U test value of (24), statistical significance (0.000), and a large effect size of (1.11).

5. Discussion

The study results revealed statistically significant differences between the experimental and control groups on the post-test measurement of the overall score for statistical thinking skills related to the labor market. This result is consistent with Abdul Hamid's studies (2006; Ali,2011; Al-Rawahy, 2017; Musa, 2022; Altaylar & Kazak, 2021) regarding the development of statistical thinking skills.

The results also showed statistically significant differences between the experimental and control groups on the post-test measurement for the four skills: statistical knowledge, statistical calculations, handling tables and graphs, and statistical inference, in favor of the experimental group.

The effect size was significant for the skill of statistical knowledge, with a value of (0.54), indicating the effectiveness of the statistical learning tasks based on Excel. Statistical knowledge is

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the student's ability to understand terms and concepts within the contexts in which they are applied (Watson & Callingham, 2003). Given that the context was professional through the Excel program, this stimulated student engagement and interaction with the tasks. This is supported by (Griffith et al., 2012), whose study showed that improved statistical learning is linked to its professional applications.

The effect size was also significant for the skill of statistical calculations, with a value of (0.54), reflecting the effectiveness of the statistical learning tasks based on Excel. Statistical calculation skills are crucial for engaging in the labor market (Lee et al., 2018). Using the Excel program, these skills measure the students' ability to apply central tendency measures, such as the mean, median, and mode, in professional contexts related to their careers. Therefore, this result contrasts with the study of (Saidi & Siew, 2019), which showed insufficient understanding in applying central tendency calculations.

Additionally, the effect size was significant for the skill of handling tables and graphs, with a value of (0.56), a substantial value reflecting the effectiveness of Excel-based statistical learning tasks in developing this skill. This result aligns with (George & Kumah, 2021), who significantly improved students' performance in creating Excel graphs. This skill is central to studies on statistical thinking, mainly through data representation. Students worked on statistical tasks to represent data in various graph forms and assessed the suitability of each graph for different types of data.

Regarding statistical inference, this skill is considered one of the highest levels of statistical thinking because it requires students to engage in sub-skills such as comparing data, explaining statistical processes, evaluating data, and justifying conclusions. Despite the complexity of these skills, the effect size was large, with a value of (1.11), strengthening the effectiveness of Excel-based statistical learning tasks. The tasks were designed to accommodate multiple solutions, allowing students to innovate responses and justify them scientifically. This was reflected in the outcome of this skill in the post-test.

Although the overall outcomes were positive, challenges emerged during the implementation phase. Some students encountered conceptual difficulties, struggling to grasp fundamental concepts, which led to errors when reading statistical tables or interpreting results. These misunderstandings can lead to poor decision-making due to incorrect data interpretations, creating potential risks in professional settings. Furthermore, procedural challenges arose, especially concerning mathematical calculations in statistics. Neglecting critical mathematical knowledge, such as fractions and algebraic formulas, undermines the learning of statistical principles. This neglect can trigger a cycle of confusion and frustration, ultimately eroding students' confidence and expertise in statistics.

Institutional and cultural factors significantly influence study outcomes. Addressing these factors is crucial to enhance the effectiveness of statistical learning and equip students for success in the job market. Despite the study's favorable results, traditional lecture-based teaching methods prevail in the educational environment. This approach can hinder student engagement and exploration in statistics courses, resulting in lower statistical reasoning skills. Relying on lectures may not sufficiently prepare students for practical applications in the job market, as they may struggle to interpret and analyze real-world data. Cultural perceptions of mathematics and statistics can significantly affect students' confidence and willingness to engage in these subjects. If a culture perceives statistics as overly complex or irrelevant, students might develop negative attitudes toward learning, negatively impacting their performance and understanding of statistical concepts. Suppose institutions do not adapt their curricula to meet the changing needs of employers. In that case, students may graduate lacking the necessary skills, leading to poor performance in statistical tasks relevant to their future careers.

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6. Conclusion and limitations

The study results revealed that Excel-based statistical learning tasks effectively develop statistical thinking skills among students. These skills are crucial for success in the job market, particularly for banking and finance diploma program students. The study also showed significant improvements in the performance of the experimental group compared to the control group. This improvement is attributed to the tasks designed using Excel, which effectively enhanced skills such as statistical knowledge, calculations, data table management, graph creation, and statistical inference. The results demonstrated statistically significant differences between the experimental and control groups, with large effect sizes for various skills. This indicates the substantial impact of Excel-based tasks on students' statistical thinking abilities.

The findings of this study align with previous research highlighting the benefits of using Excel to improve students' abilities to create and interpret graphs, a key component of statistical thinking. The study suggests that future research could explore additional areas where Excel-based learning tasks can be applied. It also recommends integrating these tasks into curricula for teaching statistics courses, as they have proven effective in developing essential job market skills.

The paper emphasizes the importance of incorporating software-based practical learning tasks into educational programs to better prepare students for future job opportunities.

The study faces several limitations that may affect its results, most notably the limited sample size, which may affect the reliability and generalizability of the results. The use of non-parametric tests, such as the Mann-Whitney test, was necessary due to violations of normality and homogeneity of variances, which may limit the scope of the analyses. In addition, the study was conducted in a specific educational setting (the Applied College), which may affect the generalizability of the results to other institutions due to differences in curricula, teaching methods, and student demographics.

7. Suggestion

Given the effectiveness of Excel-based statistical learning tasks in enhancing statistical thinking skills, it is recommended that these tasks be integrated into the curricula of statistics courses. This integration can help students develop essential skills in the job market, such as statistical knowledge, calculations, data processing, visualization, and statistical inference.

The study highlighted the importance of engaging students in professional contexts. Therefore, designing tasks that simulate real-world applications of statistics in professional settings can enhance student engagement and learning outcomes. This approach aligns with the study's findings, which indicate that professional applications of statistical learning improve student performance.

While the study focused on students in the Banking and Finance diploma program, the positive findings suggest that similar Excel-based tasks could benefit other disciplines requiring statistical skills. Expanding this approach to additional fields could help a broader range of students prepare for the job market.

To maximize the benefits of Excel-based learning tasks, it is crucial to provide educators with training on effectively implementing these tasks in their teaching. This training should include strategies for fostering metacognitive skills, which have been shown to enhance problem-solving abilities and student outcomes.

Further studies could explore the long-term impact of Excel-based statistical learning on students' career success. Additionally, research could investigate the effectiveness of these tasks in different educational settings and among diverse student groups to validate and extend the study's findings.

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Declarations

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