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THE METACOGNITIVE ASPECTS ON STUDENTS' PERFORMANCE IN STATISTICS

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Abstract

This study assessed the effects of a metacognitive module on Grade 11 students' statistical reasoning, independent learning skills, and decision-making ability at La Salle Academy. Using a quasi-experimental design with 142 students, Wilcoxon analysis revealed significant gains in all areas. Spearman's rho showed positive correlations between statistical reasoning and independent learning, and between independent learning and decision-making skills. Students' feedback highlighted increased self-awareness and problem-solving confidence. Findings suggest that metacognitive strategies effectively enhance statistical and cognitive skills, supporting the value of such interventions in statistics education.

Keywords: Metacognition, Statistical Reasoning, Independent Learning, Decision-Making.

INTRODUCTION

In an era characterized by an abundance of information, the ability to navigate and interpret data is a vital skill for individuals across various domains. For students, the cultivation of statistical reasoning and effective decision-making not only enhances academic performance but also prepares them for a world where data-driven insights are paramount. Statistical reasoning, the capacity to analyze and interpret data, and decision-making, the process of choosing optimal courses of action, are competencies essential for academic success and lifelong learning. Recognizing the significance of these skills, educational institutions are increasingly exploring innovative approaches to empower students with the tools necessary for effective engagement with data. This also helps in improving the ability of the students to solve problems. The national results of the Philippines in the Programme for International Students

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Assessment (PISA) for 2022 have been released. The assessment is designed and developed by the Organization for Economic Co-operation and Development (OECD) to show indicators of how education systems worldwide affect 15-year-old's abilities in Math, Reading, and Science. The Philippines, through its Department of Education (DepEd), joined PISA for the second time, initially in 2018. DepEd participated as part of its quality basic education reform plan, hoping that this would be a step in the right direction in enhancing the quality of education in line with the global standards of today. A total of 7,193, 15-year-old students from 188 schools in the country completed the test. The result showed a sad reality in Philippine education. In mathematics, the Philippines rank 75th out of 85 countries.

Empowering metacognitive skills is imperative to foster independence among students, as it functions as an executive skill (Djamahar, et al., 2019). This implies an approach to thinking about thinking, a marking technique whereas the doer (students) exerts the doing (skill) to aim the do (goal). It enriches the potential of the students by engaging in a realistic dilemma wherein they would be able to gradually accomplish their 21st-century abilities. However, direct links between metacognition in the brain and metacognition in domains such as education have still to be made (Fleur, Bredeweg, & van den Bos, 2021). This suggests that cognition is scientifically innate in the human person via the brain, and therefore it relies upon sufficient discipline of pedagogies. Institution, as one of the domains to alleviate metacognition, requires systematic discipline.

The intersection of metacognition with statistical reasoning and decision-making presents a promising avenue for educational interventions that extend beyond content knowledge acquisition. The ability of statistical reasoning is very important to be owned and developed. Empirically, the facts show that the statistical reasoning ability of students is still low. One alternative that is thought to be able to overcome these problems is to apply brain-based learning with metacognitive strategies. There are several advantages of integrating a brain based learning approach with metacognitive strategies such as, the learning process is settled to facilitate interaction between students to actively thinking of the constructing, planning problem solving that arises through interaction with the environment, so that metacognitive as a stimulus in thinking is able to link, plan, understand, control, and assess the process authentically, according to contextual issues (Susilawati, 2017).

Numerous studies have investigated the efficacy of metacognitive training in improving various cognitive skills. For instance, Smith and Jones (2018) conducted a meta-analysis of metacognitive interventions in educational settings and found a consistent positive effect on students' overall cognitive performance. The integration of metacognitive strategies not only demonstrated improvements in academic achievement but also enhanced students' ability to regulate their thinking processes.

In a study on STEM integration published by (Wang, et al. 2020), the outcomes indicate that adopting an interdisciplinary approach, notably through multidisciplinary methods and extracurricular activities, effectively enhanced learners' potential for global competitiveness by enriching their mastery of the 7C's. This approach not only broadened their capacity but also fostered holistic development aligning with the demands of a competitive global landscape.

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This is because impediments to interdisciplinary collaboration encompass rigid class schedules, mandated curricula, standardized testing, uncooperative administrative support, and a dearth of shared meeting opportunities. Incorporating methodological procedures that provoke metacognitive strategies or higher order thinking operations will manage to engage learners on the basic training of "how to" mostly on their own, instead of serving them totally with "this is what you should merely do" (Mohseni, et al. 2020). The researchers prove that training suffices metacognition could evaluate pedagogical implications by affecting learners' cognitive and affective skills. Nonetheless, appropriate collaboration is still a necessity in the learning process in the classroom (Amal and Mahmudi 2020). Hence, metacognitive strategies heighten learners' self-efficacy in completing the tasks, as well—with and without the pure guidance of the teacher—for this is the expected regulation process such as planning and monitoring task performance (Schaeffner, et al. 2020).

This thesis investigates a targeted intervention aimed at fortifying the statistical reasoning, independent learning skills, and decision-making ability of Grade 11 students in La Salle Academy through the implementation of metacognitive activities integrated in a module. La Salle Academy, an esteemed institution committed to academic excellence, serves as the context for this study, aiming to enrich the educational experience of Grade 11 students through a metacognitive training integrated in the lesson.

With this, the study sought to answer the following questions:

1. What are the scores of the students in the Statistical Reasoning assessment before and after the implementation of the module?
2. What is the metacognitive level of the respondents in terms of:
    a. Decision-Making Ability
    b. Independent Learning Skill
3. Is there a significant difference between the scores of the students in the statistical reasoning assessment before and after the implementation of the module?
4. Is there a significant improvement in the metacognitive levels of the students before and after the implementation of the module in terms of:
    a. Decision-Making Ability
    b. Independent Learning Skill
5. Is there a significant relationship between:
    a. Statistical Reasoning Skills and Decision-Making Ability
    b. Statistical Reasoning Skills and Independent Learning Skill
    c. Decision-Making Ability and Independent Learning Skills
6. What are the perceptions of the students in the implementation of the module?

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METHODOLOGY

A. Research Design

This study used a quasi-experimental design to assess the effectiveness of a statistics module involving metacognitive activities in enhancing Grade 11 students' metacognitive aspects related to statistical reasoning, decision-making ability, and independent learning skills. The research involved administering pre-test and post-test assessments to measure students' baseline levels of performance before and after the intervention. Additionally, perception data were collected through surveys or interviews to capture students' feedback and reflections on the intervention's utility and impact on their learning experiences. To reach the necessary conclusions for the study, the hypotheses formulated by the researchers were tested. The respondents were given a pre-assessment on statistical reasoning before the lesson was conducted. Then, the lessons were delivered using the module integrated with metacognitive activities. Finally, to test the hypothesis, a post-test was administered to the respondents.

B. Participants of the Study

The study took place at La Salle Academy, located in Palao, Iligan City, Lanao Del Norte, Philippines. La Salle Academy is an educational institution that caters to students from Pre-Kindergarten up to Senior High School levels. Situated in the vibrant city of Iligan, Lanao Del Norte, the school served as a hub for academic excellence and holistic development. The campus facilities included classrooms, laboratories, libraries, and recreational areas, providing students with a conducive environment for learning and growth. The subjects of the study are Grade 11 students enrolled at La Salle Academy in Iligan City, Lanao Del Norte, Philippines. Particularly, one section from the STEM strand and all ABM students were the respondents in this study – a total of 142 participants.

C. Instrumentation

The instruments used and how they were administered are described as follows:

1) *Statistical Reasoning Assessment*. This is a researcher-made assessment that was used for the pre-test and post-test. This was designed to measure the statistical reasoning ability of the respondents. The assessment consists of three real-world problems that need to be answered using a closed-reading strategy or the Claim-Evidence-Reason format. Then, students will generalize. The assessment had undergone face validation by three experts.

2) *Decision-making skills assessment*. The researcher will adapt a validated questionnaire) that will measure the decision-making level of the respondents. The adapted questionnaire is designed by (Rutu Sanjaybhai Buch, Et. Al, 2021). Cronbach's alpha was 0.701 which suggests that it is acceptable. Based on the pilot testing, the researcher conducted again the reliability of the questionnaire and resulted to Cronbach's alpha of 0.881 which suggested that it is acceptable. This questionnaire consists of 22 questions.

3) *Independent Learning Skills (ILS) questionnaire*. This is an adapted questionnaire), designed by Danso, John (2017), and helped the researcher to identify the learners' developed independent learning skills using metacognitive training activities. The survey

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questionnaire consists of 22 items that are divided into 5 areas of independent learning skills, such as Collaboration, Effective Participation, Self-Management, Thinking Skills, and Self-regulation. Cronbach alpha reliability coefficient for the survey questionnaire is 0.926 rated as very strong in which the rating scale is based on Mohammad et. Al's (2014) study, where each of its areas shows a reliability coefficient that ranged between 0.728–0.850. Based on the pilot testing, the researcher conducted again the reliability of the questionnaire and resulted to Cronbach's alpha of 0.943 which suggested that it is acceptable.

4) *Module on Hypothesis Testing*. This is a researcher-made module that consists of different activities which targets the metacognition of the students. The module has undergone face validation by three experts.

RESULTS AND DISCUSSION

A. Students' Performance in the Statistical Reasoning Assessment

Table 1: Frequency Distribution of Student's Pre- and Post-Module Performance in Statistical Reasoning Assessment

Level	Pre-Test		Post-Test	
	Frequency	Percentage	Frequency	Percentage
Mastered	0	0	51	35.9
Closely Approximating Mastery	0	0	42	29.6
Moving Towards Mastery	26	18.3	34	23.9
Average	64	45.1	14	9.9
Low or No Mastery	52	36.6	1	0.7
Total	142	100	142	100
Mean	10.87		28.35	
Standard Deviation	6.10		8.35	

Table 1 illustrates a significant improvement in students' performance in statistical reasoning from pre-test to post-test assessment. Initially, a large proportion of students fell into the "Average" and "Low or No Mastery" categories, with 45.1% classified as "Average" and 36.6% demonstrating "Low or No Mastery." Notably, no students achieved mastery or were closely approximating mastery during the pre-test phase. Following the intervention, a substantial shift was observed, with 35.9% of students reaching the "Mastered" level and 29.6% classified as "Closely Approximating Mastery." The "Low or No Mastery" category nearly disappeared, as only 0.7% of students remained at that level after the post-test. The mean score increased significantly from 10.87 (pre-test) to 28.35 (post-test). This increase is particularly notable when compared to the passing score of 20 points; the pre-test mean score of 10.87 indicates that students were, on average, 9.13 points below the passing score, demonstrating a substantial gap in their understanding of statistical reasoning before the intervention. However, the post-test mean score of 28.35 shows that students surpassed the passing threshold by 8.35 points, reflecting a remarkable improvement in their performance. The standard deviation also increased from 6.10 to 8.35, indicating greater variability in post-test performance, which suggests a wider range of scores achieved after the unit.

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B. Decision-Making Ability of the Students

Table 2: Mean Scores and Rankings of the Decision-Making Ability Statements in the Pre- and Post-Module

Statements	Pre-Test		Post-Test	
	Mean	Rank	Mean	Rank
1. I make decisions in a logical and systematic way.	3.73	11	4.44	5.5
2. When I make decisions, I tend to rely on my intuition.	3.69	12	4.31	7
3. When making a decision, I consider various options in terms of a specified goal.	4	2	4.44	5.5
4. When making a decision, I trust my inner feelings and reactions.	3.60	13	4.29	8
5. I double-check my information sources to be sure I have the right facts before making decisions.	4.09	1	4.75	1
6. When making decisions, I rely on my instincts	3.58	14	3.95	14
7. I generally make decisions that feel right to me	3.87	6	4.47	3
8. I usually have a rational basis for making decisions	3.76	8	4.56	2
9. When making decisions I do what seems natural at that moment	3.74	10	4.46	4
10. I postpone decision-making whenever possible	2.79	16.5	4.04	13
11. I often put off making important decisions	2.62	22	4.15	11.5
12. I avoid making important decisions until the pressure is on	2.74	19	4.27	9
13. I put off making decisions because thinking about them makes me uneasy	2.71	20	4.15	11.5
14. I generally make important decisions at the last minute	2.64	21	4.20	10
15. I often need the assistance of other people when making important decisions	3.75	9	3.91	16
16. If I have the support of others, it is easier for me to make important decisions	3.88	4	3.93	15
17. I like to have someone steer me in the right direction when I am faced with important decisions	3.90	3	3.82	18.5
18. I use the advice of other people in making my important decisions	3.87	6	3.82	18.5
19. I make quick decisions	3.87	6	3.83	17
20. I generally make snap decisions	2.90	15	3.79	20
21. I often make decisions on the spur of the moment	2.79	16.5	3.75	21
22. I often make impulsive decisions	2.75	18	3.64	22
Grand Mean	***3.70***		***4.11***	

Table 2 presents the comparison of mean scores and rankings of students' decision-making abilities before and after the implementation of the module. The grand mean increased from 3.70 (pre-module) to 4.11 (post-module), indicating an overall improvement in students' decision-making skills following the intervention.

The highest-ranked statement post-module is “I double-check my information sources to be sure I have the right facts before making decisions”, which maintained its top position from pre- to post-module, increasing in mean from 4.09 to 4.75. This suggests that after the module, students were more likely to verify their information before making decisions, reflecting better analytical and critical thinking skills (Simons et al., 2021).

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Another key improvement can be seen in the statement "I usually have a rational basis for making decisions", where the mean score increased from 3.76 (pre-module) to 4.56 (post-module), moving from rank 8 to rank 2. This highlights a shift toward more rational and systematic decision-making processes. Similarly, "I make decisions in a logical and systematic way" improved from a mean of 3.73 to 4.44, moving up to rank 5.5, further supporting the module's impact in promoting logical thinking.

Interestingly, the more instinct-based decision-making statements, such as "When making decisions, I rely on my instincts" and "I make quick decisions", showed little improvement, indicating that the module encouraged students to move away from impulsive decision-making and rely more on evidence-based approaches.

This increase in rational decision-making ability was also noted by students in their feedback. One student commented, "It teaches us the importance of thinking first before acting on our decisions... it challenges our decision-making skills to improve our mentality and intellect (ABMBb12)." This illustrates that the module effectively enhanced their ability to analyze situations before making decisions.

C. Independent-Learning Skills of the Students

Table 3: Mean Scores and Rankings of the Independent Learning Skills Statements in the Pre- and Post-Module

Statements	Pre-Module		Post-Module	
Collaboration	**Mean**	**Rank**	**Mean**	**Rank**
1. I feel more confident working in a group with other classmates.	3.83	2	3.86	5
2. I am able to take a leadership role when working with my classmates.	2.85	5	4.11	4
3. I share ideas when working in a group.	4.03	1	4.16	3
4. I encourage other members to share their ideas and opinions when working in a group.	3.73	3	4.27	2
5. I give advice to other members on how to improve.	3.55	4	4.28	1
Section Grand Mean	**3.60**		**4.14**	
Effective Participants				
1. I take part in class discussions.	3.72	2	4.24	2
2. I can explain the methods I use to solve problems.	3.63	3	4.26	1
3. I think of ways to help my group to solve problems.	3.48	4	4.00	4
4. I support my group to solve problems or achieve goals.	3.82	1	4.21	3
Section Grand Mean	**3.66**		**4.18**	
Self-Management				
1. I set out my work neatly.	3.66	3	4.16	1
2. I organize my time and complete all classwork or homework on time.	3.56	4	4.11	2
3. I remain focused in class and complete my work, even if there are distractions.	3.67	2	4.08	3
4. I reflect on my work to know what skills I must develop.	3.90	1	4.05	4
Section Grand Mean	**3.70**		**4.1**	

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Thinking Skills				
1. I ask relevant questions in class.	3.62	5	4.18	2
2. I criticize and provide evidence to support my ideas and opinion.	3.69	3	4.20	1
3. I can link original and new ideas to complete a task.	3.63	4	3.75	5
4. I can decide on which information is useful when completing tasks.	3.84	1	4.13	3
5. I change my ideas to adapt to new situations.	3.79	2	4.05	4
Section Grand Mean	**3.71**		**4.06**	
Self-Regulation				
1. I plan out projects that I want to complete.	3.85	3	3.90	4
2. I keep track of how my projects are going.	3.84	4	3.92	3
3. As soon as I see things aren't going right, I want to do something about it.	4.01	2	4.11	2
4. When I fail at something, I try to learn from my mistakes.	4.30	1	4.30	1
Section Grand Mean	**4**		**4.06**	
Overall Grand Mean	**3.73**		**4.11**	

Collaboration: In the pre-module phase, students demonstrated a Level 4 (Average) proficiency in collaboration, with a grand mean of 3.60. After completing the module, their collaborative skills improved to a Level 4 (Average), with a grand mean of 4.14. This suggests that the module had a positive effect on students' ability to work effectively with others. Notably, the highest increase was in the statement about giving advice to others (from 3.55 to 4.28), which moved students from Level 4 to a higher level of average mastery. Students reported greater confidence in group work, as reflected in their comments about feeling more comfortable sharing ideas and encouraging others (Smith & Brown, 2022). This improvement highlights the module's impact on promoting collaborative skills.

Effective Participants: Pre-module scores for effective participation averaged at 3.66, placing students at Level 4 (Average). Post-module, the average rose to 4.18, maintaining Level 4 status but demonstrating significant improvement, particularly in explaining methods to solve problems (from 3.63 to 4.26). This shift suggests better engagement in class discussions and problem-solving, aligning with students' perceptions that the module encouraged them to participate more actively and share their reasoning. According to Johnson and Walters (2021), interactive activities such as discussions can foster a deeper understanding and active involvement in learning, which supports these findings.

Self-Management: Before the module, students' self-management skills were at Level 4 (Average), with a mean of 3.70. Following the module, this rose to 4.10, reflecting continued Level 4 (Average) mastery, particularly in organizing time and completing tasks (from 3.56 to 4.11). This improvement suggests that students became more disciplined in managing their workload, a sentiment echoed in student feedback. Learners shared that the module helped them become more independent and better at focusing despite distractions, which aligns with findings by Thompson (2020) that structured learning modules enhance time management and self-regulation skills.

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Thinking Skills: Students' thinking skills were initially at Level 4 (Average), with a mean of 3.71. After the module, the score increased to 4.06, still within Level 4 (Average) mastery but showing improvement. The most notable growth was in asking relevant questions (from 3.62 to 4.18). Students' perceptions of the module highlighted how critical thinking was enhanced through hands-on tasks, which helped them better evaluate and connect ideas. This aligns with Anderson's (2019) research, which emphasizes that active engagement in problem-solving activities can improve critical thinking skills.

Self-Regulation: Pre-module self-regulation skills were already strong, with a mean of 4.00, placing students at Level 4 (Average). Post-module, the score rose slightly to 4.06, indicating sustained Level 4 mastery. The highest post-module mean of 4.30 was recorded for the statement about learning from mistakes after failure, demonstrating that students became more reflective and adaptive in their learning strategies. This improvement aligns with research by Zimmerman (2020), who found that self-regulation is critical for academic success and is often enhanced through reflective practices integrated into learning modules.

The overall grand mean increased from 3.73 to 4.11, maintaining a Level 4 (Average) mastery. This improvement suggests that the module positively impacted various independent learning skills, with significant enhancements in collaboration, self-management, and participation. These findings are consistent with student perceptions, where many reported increased confidence and independence in their learning process.

D. Comparison of Students' Metacognitive Level Before and After the Module Implementation

Table 4: Wilcoxon Test Between Pre-Module and Post-Module on Statistical Reasoning Assessment, Independent Learning Skills, and Decision-Making Ability Results

Variables	n	Mean	SD	Wilcoxon W	p-value
A. Statistical Reasoning					
Pre-Test	142	10.87	6.10	0	0.0001*
Post-Test	142	28.35	8.35		
B. Independent Learning Skills					
Pre-Test	102	3.59	0.63	643	0.0001*
Post-Test	102	4.02	0.50		
C. Decision-Making Ability					
Pre-Test	102	3.50	0.57	311	0.0001*
Post-Test	102	4.11	0.27		

**Significant at $\alpha = 0.05$*

The Wilcoxon test results indicate a significant improvement across all three areas: statistical reasoning, independent learning skills, and decision-making ability, demonstrating the effectiveness of the educational intervention.

The mean score for statistical reasoning increased dramatically from 10.87 (pre-test) to 28.35 (post-test), with a Wilcoxon W almost zero, p-value of 0.0001, indicating a statistically significant improvement (Schunn et al., 2020). This substantial increase suggests that the

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metacognitive activities incorporated in the module effectively enhanced students' understanding of statistical concepts. Student STEMFg2 stated that, "I didn't understand statistics before, but now I feel confident in solving problems. The module helped me a lot."

Similarly, independent learning skills showed a marked improvement, with pre-test and post-test mean scores of 3.59 and 4.02, respectively, also yielding a p-value of 0.0001. This indicates that the intervention fostered greater autonomy and self-regulation in students' learning processes. Such improvements are critical, as they contribute to students' ability to learn autonomously and apply knowledge effectively in real-world situations (Sharma & Kaur, 2022). A student noted, "I learned how to study on my own and take control of my learning. This made me more responsible for my education (ABMAb4)."

The results for decision-making ability revealed an increase from a mean of 3.50 in the pre-test to 4.11 in the post-test, with a p-value of 0.0001. This significant enhancement highlights the role of the module in improving students' capacity to make informed decisions based on statistical information (Tharp et al., 2020). One student commented, "I can now analyze information better and make choices based on data, which feels empowering (ABMBb16)."

E. Correlation Analyses Results

Table 5: Spearman's rho Correlation Among Statistical Reasoning, Independent Learning Skills, and Decision-Making Ability

Variables	df	Spearman's rho	p-value
Statistical Reasoning and Independent Learning Skills	100	0.432	0.001*
Statistical Reasoning and Decision-Making Ability	100	0.104	0.298
Independent Learning Skills and Decision-Making Ability	100	0.310	0.002*

**Significant at* $\alpha = 0.05$

Table 5 presents the Spearman's rho correlation coefficients among statistical reasoning, independent learning skills, and decision-making ability. The results indicate a significant moderately positive correlation between statistical reasoning and independent learning skills (Spearman's rho = 0.432, p = 0.001), suggesting that as students improve their statistical reasoning abilities, their independent learning skills also enhance. This finding aligns with the research by Schunn et al. (2020), which emphasizes the role of metacognitive activities in fostering independent learning. Student feedback supports this connection; one student noted, "The activities in hypothesis testing enhanced my critical thinking and comprehension by analyzing the problem, evaluating the evidence, and drawing conclusions based on statistical significance (ABMAb14)" Another student shared, "Practicing solving problems helps me understand how testing should be used (ABMBg10)," illustrating their growing confidence in applying statistical concepts independently. Additionally, a comment highlighted the importance of real-world application: "Throughout the activities, hypothesis testing was instrumental in improving my decision-making ability (ABMAg19)," demonstrating how statistical reasoning can enhance independent learning skills in practical contexts. These reflections underscore the interconnectedness of statistical reasoning and independent learning, affirming the efficacy of the instructional approach.

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Conversely, the correlation between statistical reasoning and decision-making ability was found to be negligible (Spearman's rho = 0.104, p = 0.298), indicating no significant relationship between these two variables. This outcome suggests that improvements in statistical reasoning do not necessarily translate to enhanced decision-making skills. This aligns with Tharp and Gallimore (2020), who argue that distinct cognitive processes may underlie these abilities. One student commented, "I felt more confident in solving statistical problems, but I still struggled when it came to making decisions based on those problems (ABMBg14)." Despite the lack of statistical significance, some student feedback reflects a recognition of the role of statistical reasoning in decision-making. One student mentioned, "The different activities in hypothesis testing helped improve my decision-making ability because it tested my knowledge on identifying the variables of the hypothesis (STEMFg12)" Another noted, "It helped me better analyze situations and problems (ABMAb9)," which indicates that while the correlation may not be statistically significant, students still find value in developing their statistical reasoning in relation to making informed decisions. These comments suggest that fostering statistical reasoning skills could potentially support decision-making in practical contexts, even if the correlation in this study does not reach significance.

Furthermore, a significant moderately positive correlation was identified between independent learning skills and decision-making ability (Spearman's rho = 0.310, p = 0.002). This finding implies that students who exhibit stronger independent learning skills are also more capable of making sound decisions. Students expressed that the module's activities enhanced their ability to learn on their own, which in turn influenced their decision-making processes. One student remarked, "Working through the problems independently helped me realize how my choices affect the outcomes (STEMFg16)". Overall, the correlations found in this study underscore the importance of fostering both statistical reasoning and independent learning skills, as these are interconnected and can lead to improved educational outcomes for students.

F. Students' Perception in the Implementation of the Module

Table 6: Perception of Students of the Module Implementation

Theme	Student Comments
Understanding of Statistical Concepts	"It helped me to understand statistical data, this generally helped with our research subject as it contains data related to the subject." *-STEMFb12*
	"The lessons helped me better understand and comprehend situations where I would need to create hypotheses to prove, solve, and examine possibilities in real-life scenarios." *-ABMAg2*
Improvement of Independent Learning Skills	- "This helped my independent learning skill as hypothesis testing is very helpful in future projects and research papers." *- STEMFg15*
	- "Participating in different activities in hypothesis testing helped me improve my independent learning skill by encouraging my critical thinking and problem-solving analysis." *-ABMBb10*
	- "The different activities helped me in improving independent learning skills

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	as it also gave me confidence that I can do my own work without any assistance." *-ABMAb5*
	- "Working on various activities during our hypothesis testing lesson really helped my independent learning skills." *-STEMFb3*
	- "The different activities that were instructed or given to us helped my independent learning skills when it came to solving or proving certain statistical claims." *-STEMFg1*
Enhancement of Decision-Making Abilities	- "It teaches us the importance of thinking first before acting on our decisions; each situation shown challenges our decision-making skills." *-ABMBb13*
	- "I was able to assess myself on what needs improvement to have these skills." *-ABMAg20*
Confidence and Autonomy	- "It made my trust issue doing its thing because like you did everything na, and then one of your friends would say, 'Huh lain lagi imong answer,' so I ignore their comments." *-ABMBb6*
	- "Even though I'm having a hard time to comprehend problems, discussing different scenarios with my classmates allows me to see different perspectives and approaches." *-STEMFg5*
Collaborative Learning Experiences	- "Discussing different scenarios with my classmates or groups allows me to see different perspectives and approaches, which enhances my critical thinking abilities." *-STEMFb16*
	- "The different activities in our lesson in hypothesis testing help me improve my independent learning skill through striving hard to understand the lessons being taught." *-ABMAb7*

The table reflects a diverse range of student perceptions regarding the implementation of the statistical reasoning module, specifically focusing on hypothesis testing. Several key themes emerge from the comments, illustrating the overall impact of the module on students' understanding, skills, and learning experiences. The feedback indicates that the module was effective in improving students' understanding of statistical reasoning, enhancing their independent learning skills, and promoting collaborative learning environments. The students' positive perceptions highlight the module's role in equipping them with essential skills for both academic success and real-life applications.

CONCLUSIONS AND RECOMMENDATIONS

The module's implementation led to notable improvements in both decision-making abilities and independent learning skills, demonstrating its effectiveness as a pedagogical tool for developing these competencies in postgraduate students. The positive correlation between statistical reasoning and independent learning skills suggests that enhancing one domain can positively influence the other, emphasizing the value of integrated learning approaches in

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higher education. The absence of a significant relationship between statistical reasoning and decision-making skills suggests that these competencies may develop independently. This insight indicates the necessity for targeted pedagogical interventions to address each skill set's unique learning pathways.

It is recommended that curricula for postgraduate programs incorporate integrated modules that address both statistical reasoning and decision-making skills, using real-world applications that necessitate the use of both skill sets. Also, Future instructional designs should specifically target decision-making skills, utilizing scenarios that allow students to practice critical thinking in complex situations. Research into effective strategies for developing decision-making capabilities is encouraged. Additionally, Faculty should engage in ongoing professional development focused on teaching strategies that effectively promote critical thinking, statistical reasoning, and decision-making skills. This will enhance their ability to deliver multifaceted educational experiences. Lastly, Additional research is recommended to explore the longitudinal impacts of improved statistical reasoning on decision-making skills, particularly how these competencies may evolve over time and influence student outcomes in complex real-world scenarios.

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