cognizancejournal.com
Nevel Taurine C. Auxilio *et al*, Cognizance Journal of Multidisciplinary Studies, Vol.5, Issue.9, September 2025, pg. 204-215
(An Open Accessible, Multidisciplinary, Fully Refereed and Peer Reviewed Journal)
ISSN: 0976-7797
Impact Factor: 5.183
Index Copernicus Value (ICV) = 92.57

Assessing the Impact of Research Capability Mentoring on Science and Technology Readiness in Senior High School Students and Teachers: A Case Study of Cagayan de Oro National High School

Nevel Taurine C. Auxilio[1]; John Irwin C. Fabela[2]

University of Science and Technology of Southern Philippines, Jasaan Campus, Philippines
[1] neveltaurine.cuasito@ustp.edu.ph; [2] johnirwin.fabela@ustp.edu.ph

DOI: 10.47760/cognizance.2025.v05i09.015

Abstract: This study addresses the critical need to enhance student and teacher research skills, attitudes, and practical competencies in Science, Technology, and Innovation activities – a gap identified in current educational programs. The objective was to evaluate the effectiveness of a mentoring intervention designed to improve these outcomes among students and teachers. Employing a mixed-methods approach, quantitative data were analyzed using paired sample t-tests to assess changes in research skills and attitudes, while qualitative data gathered from teacher interviews contextualized these effects through thematic analysis. The results revealed statistically significant improvements in research competencies and positive shifts in attitudes (p<.000), complemented by qualitative evidence of increased confidence, technical skill enhancement, and active student participation in national STI events and competitions. These findings suggest the mentoring program's success in fostering holistic student development, with implications for educational practice emphasizing structured mentoring and experiential learning to prepare students for competitive and professional research environments.

Keywords: paired sample t-test, qualitative and quantitative analysis, research mentoring effectiveness, student readiness

I. INTRODUCTION

Research and extension services are vital components of the academic core functions in higher education institutions in the Philippines, driving innovation and community development through the generation and application of knowledge (Constantino & Santos, 2025). These activities not only enhance the quality of education but also address socio-economic challenges caused by global technological upheaval faced by communities, fostering sustainable progress and empowerment within local and national contexts (Cuasito Sr. & Namoco Jr. 2012; Joshua, Ojonla & Temitayo, 2025). Cascading research and extension core functions into basic education through research capability mentoring among Senior High School teachers and students is essential for the early cultivation of critical thinking and inquiry skills (Kingiri, Andersen, & Hanlin, 2024). Equipping them with these competencies empowers the younger generation and their mentors to actively participate and contribute to the evolving science, technology, and innovation ecosystem, ensuring a stronger pipeline of future researchers and innovators (Lunag, Posadas, Lamadrid, Ducas, Teehankee, De Guzman, & Clemente, 2024).

Educating basic education students in science, technology, and innovation is crucial to address pressing challenges that hinder sustainable development in the Philippines, such as climate change, environmental degradation, and unequal access to technological resources (Bangay, 2022). These issues demand a workforce equipped with up-to-date scientific knowledge and innovative skills to drive solutions and economic resilience (Li, 2024). By grounding students early in these fields, the education system can help produce relevant human

©2025, Cognizance Journal, ZAIN Publications, Fridhemsgatan 62, 112 46, Stockholm, Sweden, All Rights Reserved

cognizancejournal.com
Nevel Taurine C. Auxilio *et al*, Cognizance Journal of Multidisciplinary Studies, Vol.5, Issue.9, September 2025, pg. 204-215
(An Open Accessible, Multidisciplinary, Fully Refereed and Peer Reviewed Journal)
ISSN: 0976-7797
Impact Factor: 5.183
Index Copernicus Value (ICV) = 92.57

resources capable of adapting to and leading in rapidly advancing technological landscapes, thereby supporting various economic sectors to thrive amid global shifts and ensuring long-term national progress (Jafarov, 2025).

The limited research and innovation capacity in the Philippines presents a major challenge to the country's economic stability, as technological gaps restrict competitiveness and slow inclusive growth (Mormina, 2019). This issue is worsened by a lack of interest in technopreneurship and business ventures, which hampers turning innovative ideas into viable commercial projects that could promote economic diversification and generate jobs (Halim, Ahmad, & Waqas, 2025).

Cascading research capability to basic education is essential because Senior High School students form the foundational input pool for higher education baccalaureate programs, particularly those centered on science, technology, and innovation. Strengthening research skills early ensures these students enter higher education better prepared to engage in complex scientific inquiry and technological development, ultimately enhancing the quality and relevance of the country's STEM workforce (McDonald, 2016). Moreover, early exposure to research fosters a culture of curiosity and critical thinking, which is vital for sustaining innovation and addressing national development challenges by producing informed and capable graduates.

The Department of Electronics Technology and the Department of Electro-mechanical Technology of the University of Science and Technology of Southern Philippines jointly provide extension services to Cagayan de Oro National High School, focusing on cascading research capabilities and innovation mentoring. These efforts include mentoring students and teachers in relevant parameters such as hands-on technical skills, scientific inquiry, and application of emerging technologies, aiming to strengthen the school's readiness in science, technology, and innovation (Younas, Kulsoom, & Ullah, 2025). Through this collaboration, the departments enhance the knowledge base and practical competencies of the participants, fostering a culture of innovation and technological competence essential for the evolving demands of the industry and community development. This initiative supports building a stronger pipeline of skilled individuals capable of contributing meaningfully to the country's technological ecosystem (Challoumis, 2024).

However, the perceived positive claims of the extension services have to be validated to ensure a sustainable program to prosper onward (DuBois, Doolittle, Yates, Silverthorn, & Tebes, 2006). Hence, this impact study is undertaken with the foresight of continuing research mentoring not only confined to Cagayan de Oro National High School Junior High School (CDONHS JHS) but to other JHS in Cagayan de Oro City. This impact study on the research capability mentoring provided through extension services has several compelling issues that require validation to accurately assess its effectiveness. These include evaluating the improvement in students' and teachers' research skills and attitudes toward scientific inquiry, the enhancement of practical technical competencies, and the degree to which the mentoring has increased their readiness and participation in science, technology, and innovation activities (Oguz Unver, Okulu, Muslu, Ozdem Yilmaz, Senler, Arabacioglu, & Bektas, 2023). Additionally, it is important to assess the sustainability of the mentoring benefits, such as continued application of acquired skills beyond the program, the integration of research culture within the school environment, and the influence on students' academic and career pathways in STEM fields (Ravishankar, Spencer‐Drakes, Fernandes, Hayes, Coopwood, Spencer, & Neal, 2024). Challenges related to resource availability, institutional support, and barriers to full engagement by beneficiaries also need to be examined to inform future program improvements (Wandersman, 2009).

The compelling null hypothesis regarding the measurement of the research mentoring program's impact states that there is no significant difference in participants' academic performance, research skills, or professional development outcomes before and after their involvement. This statement assumes no effect or impact, which is then tested against the alternative hypothesis that the research mentoring program does have a significant impact.

The general objective of this study is to assess the impact of the research capability mentoring conducted by the Department of Electronics Technology and the Department of Electro-mechanical Technology serving CDONHS Junior High School (JHS) teachers and students. The specific objectives are:

1. To validate the improvement of the research skills and attitude toward scientific inquiry of the teachers and students of CDONHS JHS.
2. To assess the enhancement of practical technical competencies of the teachers and students of CDO NHS JHS.
3. To measure the readiness and participation of students and teachers in science, technology, and innovation activities.
4. To assess the sustainability of the mentoring benefits, such as application of acquired skills beyond the program, integration of research culture, and influence on students' academic and career pathways.

©2025, Cognizance Journal, ZAIN Publications, Fridhemsgatan 62, 112 46, Stockholm, Sweden, All Rights Reserved

cognizancejournal.com
Nevel Taurine C. Auxilio *et al*, Cognizance Journal of Multidisciplinary Studies, Vol.5, Issue.9, September 2025, pg. 204-215
(An Open Accessible, Multidisciplinary, Fully Refereed and Peer Reviewed Journal)
ISSN: 0976-7797
Impact Factor: 5.183
Index Copernicus Value (ICV) = 92.57

II. METHODOLOGY

The overall approach for the impact study on research capability mentoring through extension services uses a mixed-method research design, combining both quantitative and qualitative methods. Data collection includes validated survey questionnaires to assess changes in knowledge, skills, and attitudes among students and teachers before and after the mentoring program. This is supported by focus group discussions and key informant interviews to gain deeper insights into the perceived benefits, challenges, and sustainability of the mentoring activities. Descriptive statistics such as means and t-tests are used to analyze quantitative data, while qualitative data are thematically examined to enhance understanding of the program's impact. The study also considers contextual factors like institutional support and resource availability to provide a comprehensive evaluation of the extension program's effectiveness and potential areas for improvement, subject to future work. The methodology aligns with the specific objectives of the study in the following contexts.

Validation of the research skills and attitude toward scientific inquiry

The validation assesses the impact of the mentoring program on participants' research skills and attitudes through pre- and post-mentoring self-assessment surveys. These surveys feature validated scales designed to accurately measure various aspects of research competence and mindset. Data collection involves administering structured questionnaires both before the mentoring program starts and immediately afterward, allowing for a direct comparison of participants' perceptions over time. Statistical analysis using paired t-tests compares the scores from the pre- and post-surveys. This approach helps determine whether any differences in research skills and attitudes are statistically significant, confirming the mentoring program's effectiveness.

Assessment of the enhancement of practical technical competencies

The assessment focuses on measuring skill development using competency checklists and performance-based parameters conducted both during and after mentoring sessions. Data collection involves practical evaluations where participants' hands-on activities are closely monitored and facilitated by mentors, complemented by additional feedback gathered through surveys and direct observations. This comprehensive approach captures both quantitative and qualitative insights into participants' skill acquisition. Data analysis uses descriptive statistics to summarize competency levels at different points, while comparisons between baseline and post-intervention results help identify changes and improvements tied to the mentoring process.

Readiness and Participation in STI Activities

This project aims to assess how research mentoring has improved participants' readiness for and involvement in science, technology, and innovation (STI) activities. The method includes gathering data through surveys and activity logs that record the frequency and types of participants' engagement in STI-related projects, competitions, and initiatives. Quantitative data on participation rates are collected systematically, while qualitative interviews are conducted to gain deeper insights into participants' perceptions of their preparedness to engage in these activities. In data analysis, averages are used to measure levels of participation. Meanwhile, thematic analysis of the interview transcripts helps identify attitudes, motivations, and perceived changes in readiness caused by mentoring. Together, these methods offer a thorough understanding of how mentoring impacts both actual involvement and preparedness in STI fields.

Sustainability of Mentoring Benefits

This section examines the sustainability of the benefits from the mentoring program through longitudinal follow-up surveys and interviews conducted several months after the program concludes. Fig. 1 shows some photos taken during the research mentoring of students and teachers, where participants were guided on the principles of scholarly research while developing their respective concepts, leading to their proposed technology solutions.

©2025, Cognizance Journal, ZAIN Publications, Fridhemsgatan 62, 112 46, Stockholm, Sweden, All Rights Reserved

cognizancejournal.com
Nevel Taurine C. Auxilio *et al*, Cognizance Journal of Multidisciplinary Studies, Vol.5, Issue.9, September 2025, pg. 204-215
(An Open Accessible, Multidisciplinary, Fully Refereed and Peer Reviewed Journal)
ISSN: 0976-7797
Impact Factor: 5.183
Index Copernicus Value (ICV) = 92.57

Fig. 1 Research Capability Mentoring and Coaching of Students and Teachers

Fig. 2 displays the thematic research mentoring and coaching of students' research groups, which were guided by faculty experts from the College of Technology at USTP-CDO. Fig. 3 depicts the final activities, where students presented their research concepts and proposals in scholarly critiques during oral presentations facilitated by their research mentors.

Data collection involves gathering information on participants' continued use of acquired skills, their ongoing involvement in research activities, and any academic undertakings or career decisions influenced by their mentoring experience. The analysis uses thematic investigation to identify recurring patterns and themes related to the lasting impact of the mentoring. This mixed-methods approach provides a comprehensive understanding of the durability and long-term value of the mentoring intervention.

Fig. 2 Thematic Research Mentoring and Coaching

©2025, Cognizance Journal, ZAIN Publications, Fridhemsgatan 62, 112 46, Stockholm, Sweden, All Rights Reserved

cognizancejournal.com
Nevel Taurine C. Auxilio *et al*, Cognizance Journal of Multidisciplinary Studies, Vol.5, Issue.9, September 2025, pg. 204-215
(An Open Accessible, Multidisciplinary, Fully Refereed and Peer Reviewed Journal)
ISSN: 0976-7797
Impact Factor: 5.183
Index Copernicus Value (ICV) = 92.57

Fig. 3 Research Mentoring Culmination: Research Presentation of Students and Teachers

III. RESULTS AND FINDINGS

The results of this study illustrate significant validation and enhancement across multiple dimensions of student development. The quantitative data affirm substantial improvements in research skills and positive shifts in research attitudes, while qualitative insights highlight meaningful growth in practical technical competencies essential for science, technology, and innovation (STI) participation. There were 25 students and 12 teachers who participated in the pre-test and post-test surveys. Furthermore, findings demonstrate increased readiness and active involvement in STI activities, including national research conference participation and competitive success, signifying the translation of acquired skills into tangible, real-world accomplishments as a result of the mentoring program. Quantitative results indicated statistically significant improvements in core research competencies, while qualitative insights reflected the meaningful development of research-related attitude, confidence, and motivation. Collectively, these outcomes underscore the mentoring program's comprehensive effectiveness in preparing students both cognitively and practically for the demands of academic and professional research environments. The variables demonstrated high reliability for both students and teachers, as indicated by their corresponding pre-test and post-test parameters according to the specific thematic questions. Table 1 shows the reliability test results with their corresponding Cronbach's alpha exceeding 0.902 for the thematic questions in this study, which strongly supports the reliability and internal consistency of the evaluation parameters for both students and teachers across pre-test and post-test, underscoring the instrument's suitability for robust data collection and meaningful interpretation. However, the slightly lower post-test alpha of 0.883 in research skills and attitude suggests a natural change in response consistency, possibly reflecting genuine shifts in the measured construct, rather than instrument weaknesses. This is an expected and interpretable pattern in pre-post designs using reliable instruments. The observed discrepancy in teachers' Cronbach's alpha likely reflects a combination of small sample size effects and meaningful evolution in teachers' responses to the thematic construct over time. This highlights the importance of interpreting reliability measures within the context of respondent characteristics and timing of data collection, especially in smaller professional groups.

TABLE 1
RELIABILITY ANALYSIS

Respondents	Thematic Parameters	Pre-Test Cronbach's Alpha	Post-Test Cronbach's Alpha
Students	Research Skills & Attitude	0.902	0.976
	Practical Technical Competencies	0.946	0.922
	Readiness & Participation in STI	0.905	0.924

©2025, Cognizance Journal, ZAIN Publications, Fridhemsgatan 62, 112 46, Stockholm, Sweden, All Rights Reserved

cognizancejournal.com
Nevel Taurine C. Auxilio *et al*, Cognizance Journal of Multidisciplinary Studies, Vol.5, Issue.9, September 2025, pg. 204-215
(An Open Accessible, Multidisciplinary, Fully Refereed and Peer Reviewed Journal)
ISSN: 0976-7797
Impact Factor: 5.183
Index Copernicus Value (ICV) = 92.57

Teachers	Research Skills & Attitude	0.951	0.883
	Practical Technical Competencies	0.950	0.908
	Readiness & Participation in STI	0.966	0.944

Validation of the research skills and attitude toward scientific inquiry

A paired t-test was employed to determine whether there is a statistically significant difference in the mean scores obtained by the same participants before and after the research mentoring program. In this study, the paired t-test compares the pre-test and post-test scores of teachers and students within their respective groups to assess improvements attributed to the mentoring program. Paired t-test was suitable because each participant provided two related measurements (pre and post-intervention), allowing for the evaluation of changes over time while accounting for individual variability. By analyzing teachers' and students' score changes independently, the paired t-test helps identify whether the mentoring effectively enhanced research knowledge and skills in each group separately.

Table 2 shows the paired t-test of students' pre-test and post-tests relative to their research skills and attitude, which yielded statistically significant differences between pre-test and post-test scores across all measured parameters related to students' research skills and attitudes. Specifically, for question 1, the mean post-test score (M=4.04, SD=.61) was significantly higher than the pre-test score (M=2.72, SD=.48), t(df) = -9.56, the patterned p-value of 0.000 for each question indicated that the observed improvements in scores are highly unlikely to be due to chance. This strong level of statistical significance provides compelling evidence to reject the null hypothesis that no change occurred.

TABLE 2
PAIRED T-TEST OF STUDENTS' PRE-TEST AND POST-TEST ON RESEARCH SKILLS AND ATTITUDE

Question	Pre-Test Mean	Pre-Test SD	Post-Test Mean	Post-Test SD	Mean Difference (Mdiff)	t	df	p	95% CI Lower	95% CI Upper
I feel confident in my ability to design a research study.	2.72	.458	4.04	.611	1.32	-9.56	24	.000	-1.605	-1.035
I am comfortable formulating research questions related to scientific inquiry.	2.52	.509	3.96	.538	1.44	-10.12	24	.000	-1.734	-1.146
I actively engage in scientific inquiry during academic activities	2.44	.506	3.92	.571	1.48	-10.36	24	.000	-1.774	-1.185
I am interested in conducting research.	2.52	.509	4.00	.500	1.48	-10.36	24	.000	-1.774	-1.185
I am knowledgeable about the technical processes involved in conducting research.	2.48	.509	3.92	.571	1.44	-9.37	24	.000	-1.757	-1.123

Table 3 also shows the paired t-test of teachers' pre- and post-tests relative to their research skills and attitude, which revealed statistically significant differences between pre-test and post-test scores across all measured parameters related to teachers' research skills and attitudes. Similarly, for question 1, the mean post-test score (M=4.58, SD=.51) was significantly higher than the pre-test score (M=2.42, SD=.51), t(df) = -19.28, The consistent p-value of .000 across the questions demonstrated that the intervention had a robust and positive impact on teachers' research capabilities and attitudes, affirming the effectiveness of the research mentoring program. This suggests that the teachers exhibited meaningful growth in their perceived and actual research skills as well as in their motivation and attitudes toward research activities.

©2025, Cognizance Journal, ZAIN Publications, Fridhemsgatan 62, 112 46, Stockholm, Sweden, All Rights Reserved

cognizancejournal.com
Nevel Taurine C. Auxilio *et al*, Cognizance Journal of Multidisciplinary Studies, Vol.5, Issue.9, September 2025, pg. 204-215
(An Open Accessible, Multidisciplinary, Fully Refereed and Peer Reviewed Journal)
ISSN: 0976-7797
Impact Factor: 5.183
Index Copernicus Value (ICV) = 92.57

TABLE 3
PAIRED T-TEST OF TEACHERS' PRE-TEST AND POST-TEST ON RESEARCH SKILLS AND ATTITUDE

Question	Pre-Test Mean	Pre-Test SD	Post-Test Mean	Post-Test SD	Mean Difference (Mdiff)	t	df	p	95% CI Lower	95% CI Upper
I feel confident in my ability to design a research study.	2.42	.515	4.58	.515	2.16	-19.28	11	.000	-2.414	-1.919
I am comfortable formulating research questions related to scientific inquiry.	2.42	.515	4.33	.492	1.91	-9.931	11	.000	-2.341	-1.492
I actively engage in scientific inquiry during academic activities	2.42	.515	4.33	.492	1.91	-9.931	11	.000	-2.341	-1.492
I am interested in conducting research.	2.58	.515	4.50	.522	1.92	-9.931	11	.000	-2.341	-1.492
I am knowledgeable about the technical processes involved in conducting research.	2.58	.515	4.25	.452	1.67	-11.726	11	.000	-1.979	-1.353

Assessment of the enhancement of practical technical competencies

A paired sample t-test was conducted to compare students' practical technical competencies in research before and after the research mentoring, as shown in Table 4. The results showed statistically significant improvements across all measured parameters, with a p-value of less than 0.000 for each question, indicating a highly significant difference. Specifically, for question 6, the mean post-test score (M= 4.0, SD=.50) was significantly higher than the pre-test score (M=2.60, SD=.500), t(df) = -10.84, p= 0.000. This pattern was consistent across all questions, suggesting the intervention effectively enhanced students' self-perceived practical technical competencies towards research.

Table 5 shows extremely low p-values (p<.001) across all questions for the teacher's paired t-test on practical technical competencies, demonstrating strong evidence to reject the null hypothesis of no change, confirming that the mentoring program had a meaningful impact on teachers' outcomes. Explicitly, for question 6, the mean post-test score (M= 4.33, SD=.49) was significantly higher than the pre-test score (M=2.67, SD=.49), t(df) = -8.864, p= 0.000. These patterned findings can be interpreted as clear indications of the program's success in promoting growth in practical technical research competencies and motivation.

TABLE 4
PAIRED T-TEST OF STUDENTS' PRE-TEST AND POST-TEST ON PRACTICAL TECHNICAL COMPETENCIES

Question	Pre-Test Mean	Pre-Test SD	Post-Test Mean	Post-Test SD	Mean Difference (Mdiff)	t	df	p	95% CI Lower	95% CI Upper
I am skilled in using technical tools and equipment relevant to my field of study.	2.60	.500	4.0	.500	1.40	-10.84	24	.000	-1.666	-1.133
I can apply practical	2.72	.458	4.04	.454	1.32	-11.854	24	.000	-1.549	-1.090

©2025, Cognizance Journal, ZAIN Publications, Fridhemsgatan 62, 112 46, Stockholm, Sweden, All Rights Reserved

cognizancejournal.com
Nevel Taurine C. Auxilio *et al*, Cognizance Journal of Multidisciplinary Studies, Vol.5, Issue.9, September 2025, pg. 204-215
(An Open Accessible, Multidisciplinary, Fully Refereed and Peer Reviewed Journal)
ISSN: 0976-7797
Impact Factor: 5.183
Index Copernicus Value (ICV) = 92.57

techniques in real-world situations.										
I am confident in my hands-on technical skills.	2.72	.458	4.04	.454	1.32	-10.524	24	.000	-1.579	-1.061
I am confident in performing technical tasks.	2.76	.522	4.16	.374	1.40	-12.124	24	.000	-1.638	-1.162

TABLE 5
PAIRED T-TEST OF TEACHERS' PRE-TEST AND POST-TEST ON PRACTICAL TECHNICAL COMPETENCIES

Question	Pre-Test Mean	Pre-Test SD	Post-Test Mean	Post-Test SD	Mean Difference (Mdiff)	t	df	p	95% CI Lower	95% CI Upper
I am skilled in using technical tools and equipment relevant to my field of study.	2.67	.492	4.33	.492	1.66	-8.864	11	.000	-2.080	-1.253
I can apply practical techniques in real-world situations.	2.83	.389	4.42	.515	1.59	-10.652	11	.000	-1.910	-1.256
I am confident in my hands-on technical skills.	2.67	.492	4.33	.492	1.66	-8.864	11	.000	-2.080	-1.252
I am confident in performing technical tasks.	2.67	.492	4.12	.515	1.45	-8.042	11	.000	-2.229	-1.271

Readiness and participation in science, technology, and innovation activities

Table 6 shows a paired sample t-test conducted to evaluate the impact of the intervention on students' readiness and participation in science, technology, and innovation (STI) activities by comparing pre-test and post-test scores. The results demonstrated a highly significant increase in both readiness and participation levels across all measured parameters, with p-values consistently less than .000.

TABLE 6
PAIRED T-TEST OF STUDENTS' PRE-TEST AND POST-TEST ON READINESS AND PARTICIPATION IN STI ACTIVITIES

Question	Pre-Test Mean	Pre-Test SD	Post-Test Mean	Post-Test SD	Mean Difference (Mdiff)	t	df	p	95% CI Lower	95% CI Upper
I have participated in science, technology, or innovation-related activities.	2.36	.489	4.08	.400	1.720	-12.680	24	.000	-1.999	-1.440
I feel prepared to take part in STI projects and competitions.	2.32	.476	4.12	.440	1.80	-15.588	24	.000	-2.038	-1.562
I am encouraged to participate more actively in STI activities.	2.36	.489	4.08	.400	1.720	-12.680	24	.000	-1.999	-1.440
I am confident in collaborating with others in STI-related initiatives.	2.48	.510	3.84	.624	1.36	-10.663	24	.000	-1.623	-1.097

Table 7 shows a low p-value (<0.000) across all questions related to teachers' readiness and participation in science, technology, and innovation activities. The result provides strong evidence against the null hypothesis of no change, confirming that the observed improvements are statistically significant and unlikely to be due to

©2025, Cognizance Journal, ZAIN Publications, Fridhemsgatan 62, 112 46, Stockholm, Sweden, All Rights Reserved

cognizancejournal.com
Nevel Taurine C. Auxilio *et al*, Cognizance Journal of Multidisciplinary Studies, Vol.5, Issue.9, September 2025, pg. 204-215
(An Open Accessible, Multidisciplinary, Fully Refereed and Peer Reviewed Journal)
ISSN: 0976-7797
Impact Factor: 5.183
Index Copernicus Value (ICV) = 92.57

chance. The mean scores post-intervention were notably higher, indicating enhanced preparedness and greater engagement of teachers in STI activities. These findings underscore the effectiveness of the intervention in fostering teachers' development, reflecting substantial gains in both the cognitive and behavioral aspects of research skills and attitudes towards STI participation.

TABLE 7
PAIRED T-TEST OF TEACHERS' PRE-TEST AND POST-TEST ON READINESS AND PARTICIPATION IN STI ACTIVITIES

Question	Pre-Test Mean	Pre-Test SD	Post-Test Mean	Post-Test SD	Mean Difference (Mdiff)	t	df	p	95% CI Lower	95% CI Upper
I have participated in science, technology, or innovation-related activities.	2.67	.492	4.50	.522	1.83	-11.000	11	.000	-2.200	-1.466
I feel prepared to take part in STI projects and competitions.	2.67	.492	4.58	.515	1.91	-12.894	11	.000	-2.244	-1.589
I am encouraged to participate more actively in STI activities.	2.75	.452	4.58	.515	1.83	-16.316	11	.000	-2.080	-1.586
I am confident in collaborating with others in STI-related initiatives.	2.75	.453	4.58	.515	1.83	-16.316	11	.000	-2.080	-1.586

Assessment of the sustainability of the mentoring benefits

Table 8 shows the open-ended, guided questions suitable for qualitative research that explored challenges related to resource availability, institutional support, and barriers to beneficiary engagement. The questions invited detailed, reflective responses that revealed deeper insights into participants' experiences and informed program improvements. The study presents the qualitative findings from guided open-ended questions posed to teachers regarding the effectiveness of the mentoring program, students' participation in national research activities, and opportunities for program improvement. The table maps each guided question to thematic coding categories derived from the teachers' responses, along with illustrative quotes.

TABLE 8
TEACHERS' RESPONSES TO GUIDED QUESTIONS ON MENTORING EFFECTIVENESS, RESEARCH PARTICIPATION, AND PROGRAM IMPROVEMENT

Guided Questions	Coding Categories/Themes	Teacher Responses
How do you perceive the effectiveness of the research mentoring?	Positive impact, confidence building, skill gains	"The mentoring was very effective; students gained confidence and improved research skills."
Did the mentoring prepare students for real-world research opportunities?	Conference participation, competition readiness	"Students were well-prepared to present at the National Research Competition and even won awards."
How did students react to participating in the conference?	Increased motivation, professional growth, pride	"Presenting nationally increased their motivation and professional confidence significantly."
What challenges did students face before/during these events?	Nervousness, time management, and technical skills.	"Some students initially struggled with public speaking and managing their research presentations."
How can mentoring support be improved related to research events?	More rehearsal time, enhanced resources, mentorship	"Providing more practice sessions and mentorship coaching would improve students' readiness further."

©2025, Cognizance Journal, ZAIN Publications, Fridhemsgatan 62, 112 46, Stockholm, Sweden, All Rights Reserved

cognizancejournal.com
Nevel Taurine C. Auxilio *et al*, Cognizance Journal of Multidisciplinary Studies, Vol.5, Issue.9, September 2025, pg. 204-215
(An Open Accessible, Multidisciplinary, Fully Refereed and Peer Reviewed Journal)
ISSN: 0976-7797
Impact Factor: 5.183
Index Copernicus Value (ICV) = 92.57

The coding categories summarize common themes such as positive mentoring impacts, increased student readiness for research conferences, motivational effects of competitive success, and identified challenges faced by students. Representative quotes provide rich, contextual evidence supporting the thematic interpretation and highlight teachers' perspectives and observations. Fig. 4 shows some compelling evidence on the positive impact of the research mentoring, where students and teachers participated in a national research conference, garnering impressive results, getting 2nd Grand Award bearing the research project on "Smart Aquaponics System: Integrating IoT-based Real-time Monitoring System for Sustainable Cultivation of Lettuce and Catfish", and Special Merit Award bearing the research project "Integrating Robotic Hand Systems with Glove-Based Sign Language Interpreters for Two-Way Communications" during the National Science and Engineering Fair at AXIAA Hotel, Quezon City, last March 15-16, 2025.

Fig. 4 Impact of the Research Mentoring and Coaching

Fig. 5 Research Undertaken by JHS Teachers

Fig. 5 depicts the research undertaken by JHS teachers who benefited from the research mentoring and coaching program conducted by the USTP Electronics Technology Department under the official extension program extended to CDONHS-JHS. The findings of their study affirm the positive impact of integrating ICT and robotics into Physics topics, fostering improved learner engagement, attitude, and problem-solving skills.

©2025, Cognizance Journal, ZAIN Publications, Fridhemsgatan 62, 112 46, Stockholm, Sweden, All Rights Reserved

The study underscores the potential of robotics in enhancing educational outcomes and preparing students for a technologically driven future.

IV. CONCLUSION AND RECOMMENDATION

The paired sample t-test revealed a statistically significant difference in the measured variables between the pre-test and post-test conditions. The t(df) = t-value, p<.000, leading to the rejection of the null hypothesis. This indicates that the intervention had a significant impact on improving the targeted outcomes. The mean scores increased from pre-test to post-test, reflecting a meaningful enhancement in the participants' research skills, attitudes, or competencies as assessed. These findings provide strong evidence supporting the effectiveness of the program in facilitating measurable positive changes within the study population.

The qualitative findings complement and enrich the quantitative results by providing detailed insights into participants' experiences and perspectives. Teachers' responses highlighted the meaningful growth in students' research skills and attitudes, as well as their increased readiness and active engagement in science, technology, and innovation activities, including national research conferences and competitions. These narratives confirm the statistical improvements observed and offer contextual evidence of the mentoring program's positive impact on both cognitive and motivational dimensions. By integrating these qualitative accounts with quantitative data, the study presents a comprehensive validation of the program's effectiveness in fostering student development and research competence.

To build on the positive outcomes of the mentoring program, it is recommended to continue and expand its implementation to further develop students' research skills, attitude, and practical competencies; increased opportunities for participation in national and even international STI activities to reinforce applied learning and motivation; provide more individualized coaching and rehearsal sessions to address presentation and technical challenges; enhance resource availability to better support research demands; and establish regular feedback mechanism for continuous program improvement. These steps aim to sustain and amplify the programs' demonstrated effectiveness in preparing students for academic and professional research contexts.

REFERENCES

1. Bangay, C. (2022). Education, anthropogenic environmental change, and sustainable development: A rudimentary framework and reflections on proposed causal pathways for positive change in low-and lower-middle income countries. Development Policy Review, 40(6), e12615.
2. Challoumis, C. (2024). The Imperative of Skill Development in an AI Revolution. In XIX International Scientific Conference. London. Great Britain (pp. 132-168).
3. Constantino, J. A., & Santos, A. R. (2025). Faculty Extensionists: Key Driver for Implementing Extension Services of State Universities in the Philippines. International Journal of Agricultural Science, Research & Technology (IJASRT) in Extension & Education Systems, 15(1).
4. Cuasito Sr., R. J., & Namoco Jr., C. S. (2012). Trends in Industrial Automation and Academic Initiatives in the Philippines: Assessment and Analysis of Mechatronics-Enabling Technologies, Skill Set Demands, and Academic Relevance. Int. J. Autom. Technol., 6(6), 757-764.
5. DuBois, D. L., Doolittle, F., Yates, B. T., Silverthorn, N., & Tebes, J. K. (2006). Research methodology and youth mentoring. Journal of Community Psychology, 34(6), 657-676.
6. Halim, H. A., Ahmad, N. H., & Waqas, A. (2025). Young technopreneur ventures' agility and competitiveness in Malaysia: role of inhibitors. Journal of Science and Technology Policy Management, 16(2), 300-313.
7. Jafarov, S. (2025). Education and Skill Development: A Pathway to Sustainable Growth. International Journal of Scientific Research and Management, 13(2), 3963-3969.
8. Joshua, C., Ojonla, J., & Temitayo, A. (2025). Community Extension Programs and Local Development: Insights from a Philippine State University.
9. Kingiri, A., Andersen, M. H., & Hanlin, R. (2024). Mentoring as a pathway to building research capacity in the field of innovation and development studies in Africa. Studies in Continuing Education, 46(1), 101-120.
10. Li, L. (2024). Reskilling and upskilling the future-ready workforce for industry 4.0 and beyond. Information Systems Frontiers, 26(5), 1697-1712.
11. Lunag Jr, M. N., Posadas, C. L., Lamadrid, R. L., Ducas, A. G., Teehankee, A., De Guzman, M. K. B., ... & Clemente, M. C. B. (2024). Building sustainable research and innovation ecosystem in Philippine higher education institutions. Educational Research for Policy and Practice, 23(1), 63-88.
12. McDonald, C. (2016). STEM Education: A review of the contribution of the disciplines of science, technology, engineering and mathematics. Science Education International, 27(4), 530-569.

©2025, Cognizance Journal, ZAIN Publications, Fridhemsgatan 62, 112 46, Stockholm, Sweden, All Rights Reserved

13. Mormina, M. (2019). Science, technology and innovation as social goods for development: Rethinking research capacity building from Sen's capabilities approach. Science and Engineering Ethics, 25(3), 671-692.
14. Oguz Unver, A., Okulu, H. Z., Muslu, N., Ozdem Yilmaz, Y., Senler, B., Arabacioglu, S., & Bektas, O. (2023). The Readiness of Stakeholders in the Scientific Inquiry-Supported Mentoring Project. International Journal of Education in Mathematics, Science and Technology, 11(1), 37-55.
15. Ravishankar, S., Spencer-Drakes, T. C., Fernandes, I. H., Hayes, M. I., Coopwood, S., Spencer, I., & Neal, S. E. (2024). Empowering STEM students: A university-wide mentorship program fostering retention and belonging. Journal of cellular physiology, 239(7), e31348.
16. Wandersman, A. (2009). Four keys to success (theory, implementation, evaluation, and resource/system support): High hopes and challenges in participation. American journal of community psychology, 43(1), 3-21.
17. Younas, Z., Kulsoom, S., & Ullah, S. (2025). The STEM readiness paradigm: Mapping teacher competencies and innovation pathways in Punjab's public schools. Social Sciences Spectrum, 4(1), 456-475.

©2025, Cognizance Journal, ZAIN Publications, Fridhemsgatan 62, 112 46, Stockholm, Sweden, All Rights Reserved