Utilizing Robotics Programming to Enhance Grade 10 Students' Interest in ICT Education

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ABSTRACT

The integration of robotics programming in ICT education has gained significant attention as a means to enhance student interest in Information and Communication Technology (ICT) education through engaging them in robotics activities. This study explores the utilization of robotics programming in increasing the interest levels of Grade 10 students in ICT education at President Quirino National High School. Utilizing a true experimental research design, the study involved two groups: an experimental group that engaged in robotics programming activities and a control group that followed the traditional ICT curriculum.

The research aimed to determine: (1) the level of students' engagement in robotics programming of the experimental group, (2) the level of students' interest in the ICT subject of the experimental group and controlled group before and after instructions, (3) the significant difference in the level of students' interest of experimental and controlled in ICT before and after instructions, (4) the significant difference in the interest in ICT education between the students who are engaged and not engaged in robotics programming, and (5) the correlation between the engagement in robotics programming enhance students' interest in the ICT subject. Data collection was carried out through a researcher-made questionnaire measuring students' engagement and interest, using a 5-point Likert scale. Statistical analyses, including mean, standard deviation, t-test, and Pearson correlation, were conducted to evaluate the impact of robotics programming on students' interest in ICT education.

Findings revealed that students in the experimental group demonstrated a significant increase in their interest in the ICT subject compared to the control group. It also revealed that even in the experimental group, their interest in ICT education is significantly higher after they are engaged in robotics programming activities than their interest before. The study also found that robotics programming fosters an increase in the interactive learning environment. These results suggest that integrating robotics programming into the ICT curriculum can be an effective pedagogical approach to enhance student motivation, engagement, and long-term interest in technology-related fields.

This study highlights the need for curriculum developers, educators, and policymakers to incorporate robotics-based learning strategies to better prepare students for future technological advancements. Further research is recommended to explore the long-term effects of robotics education in different technological learning environments.

Keywords: Robotics Programming, ICT Education, Student Engagement, Interest in ICT, Grade 10 Students, Experimental Research

INTRODUCTION

Automation through robotics in various fields of application remains more effective and humane by enhancing efficiency, convenience, and productivity. The robotics industry is experiencing rapid expansion globally, projected to grow 25% by 2025 (Statzon, 2024), which urges educational institutions to cultivate technical competencies and student interest in emerging technologies (U.S. Department of Education, 2020; UNESCO, 2023). However, despite these advancements, challenges persist, particularly the absence of standardized educational frameworks that limit the full potential of robotics integration in the curriculum in the world contexts.

Advanced science evidence for revolutionizing robotics in industries as well as in education, showing significant positive effects on student attitudes, learning outcomes, and cognitive development. For example, Sevim-Cirak and Gülsoy (2023) demonstrated improvements in students' attitudes toward ICT and STEM through robotics activities, while Erol et al. (2023) identified enhancements in Critical thinking and problem-solving capacity. (Sta. Catalina et al. (2023) and Anwar et al. (2023) further supported these findings, noting improved engagement and academic performance resulting from robotics-enhanced instruction.

Internationally, recent studies from Western countries reinforce the educational benefits of robotics integration. Bers and Sullivan (2019) found that programmable robotics kits significantly increased young students' computational thinking and engineering engagement in U.S. elementary schools. Similarly, Jordan (2023) emphasized that hands-on robotics activities stimulated long-term motivation in technology-related disciplines. In the United Kingdom, Hudson et al. (2020) observed that Arduino-based tasks fostered technical skill development and collaborative learning. Yang et al. (2023) stressed the importance of robotics as a tool for equity and access promotion in STEM education across Europe. Gomoll et al. (2021); Ferrarelli and Iocchi (2021) validated robotics' impact on understanding abstract scientific concepts and enhancing learner engagement.

Within Southeast Asia, perhaps more so in the Philippines, there has been much effort to embed robotics programming as a part of ICT and STEM curricula. Gonzales and De Leon (2023) observed heightened student engagement through the integration of robotics in secondary education. Dela Cruz and Cabile (2024) and Mendoza & Salazar (2021) found that participation in robotics competitions correlates positively with academic performance and enthusiasm for science and mathematics. These localized findings mirror international trends and the ability of robotics to be a major driver for educational innovation in the region.

Further, Alcantara and Reyes (2023) found increased student motivation through robotics programs, while Santos and Villanueva (2022) linked robotics-based learning experiences with improved academic outcomes. At the same time, Cruz and Alonzo (2020) and Bacalso and Lim (2021) brought up that robotics can improve problem-solving skills and alter students' attitudes toward technology. Pineda and De Guzman (2023) concluded that robotics education equips students with not only technical proficiency but also a deeper interest in technology-driven careers.

In Region 12 of the Philippines, recent research has explored localized applications. Santos (2022) and Dela Cruz (2023) reported that robotics programming enhances students' comprehension of ICT and supports future job readiness. Ramos and Villanueva (2021) highlighted the importance of culturally responsive robotics education that promotes inclusivity and engagement among diverse student populations.

Despite these encouraging findings, there remains a notable gap in longitudinal research on robotics education, particularly concerning sustained indicators such as active participation, collaboration, emotional engagement, and technical mastery over time. Studies by Fidai et al. (2020), Hudson et al. (2020), and Jordan (2023) call for a deeper exploration of the long-term impact of robotics programming on student engagement in ICT.

This study explored various levels of student engagement in robotics programming. Active participation was observed through hands-on activities (Alimisis, 2021), while communication and collaboration were reflected in students working together to solve problems (Teng et al., 2024). Technical proficiency involves practical experience in programming and engineering (Verner & Revzin, 2021). Positive attitudes and emotions towards robotics increase motivation and persistence (Lee & Kim, 2020), and adherence to safety protocols demonstrates students' responsibility and professionalism (Yang et al., 2023).

On the other hand, student interest was observed through active participation, where students showed ownership and accountability in teaching-learning (Suryanti et al., 2021). Curiosity leads to deeper understanding (Diate & Mordeno, 2021), and enthusiasm motivates students to invest more effort (Ibrahim et al., 2022). Quality of work improves with ICT tool usage (Cruz & Reyes, 2022), while initiative and consistency indicate proactive and steady engagement (Ibrahim et al., 2022; Bernardo, 2020). Emotional engagement helps students overcome challenges (Rotas & Cahapay, 2020), and a desire for mastery drives skill mastery (Goldhammer et al., 2022).

This study aims to address that gap by exploring the impact of robotics programming on Grade 10 students' interest in ICT. The findings contribute socially and educationally by informing policy decisions, refining curriculum design, and promoting evidence-based strategies for student engagement. In the context of Technology and Livelihood Education, integrating robotics enhances educators' capacity to deliver relevant, forward-looking instruction, empowering students to thrive in a technology-driven economy and preparing them for emerging careers in automation and digital industries.

Statement of the Problem

This study generally aimed to determine the utilization of robotics programming activity in enhancing the interest of grade 10 students in Information Technology and Communication (ICT) education.

Specific Research Questions

1. What is the level of students' engagement in robotics programming of the experimental group in terms of:

1.1 Active Participation;

1.2 Communication and Collaboration;

1.3 Technical Proficiency;

1.4 Attitudes and Emotions; and

1.5 Adherence to Safety Protocols?

2. What is the level of students' interest in ICT subject of the experimental group and Control group before and after instructions in terms of:

2.1 Active Participation;

2.2 Curiosity;

2.3 Enthusiasm;

2.4 Quality of Work;

2.5 Initiative;

2.6 Consistency;

2.7 Emotional Engagement; and

2.8 Desire for Mastery?

3. Is there a significant difference in the level of students' interest in ICT of the experimental group and the control group before and after instructions?

4. Is there a significant difference in the interest in ICT education between the students who are engaged and not engaged in robotics programming?

5. Can the engagement in robotics programming enhance students' interest in the ICT subject?

METHODOLOGY

Research Design

This study used a true experimental research design (TERD) to determine the level of student engagement in robotics programming tasks and their level of interest in ICT. According to Gautam (2017), as cited by Procalla (2023), this method is considered the most precise type of experimental research as it supports or refutes a hypothesis using a specific statistical tool analyzing the cause-and-effect relationship between different variables.

This study made two groups, one group was the Experimental Group, which was a group of students that was sent to the computer laboratory to do the given robotics programming tasks. Another group was the Control Group placed in the classroom and not sent to the laboratory, and was taught with lessons from the existing ICT curriculum. Before the tasks, both groups were given an evaluation to measure their interest in the ICT course or subject. Using an appropriate statistical tool, their data were analyzed to determine if there were significant differences.

Locale of the Study

As part of its digital rising program, the Philippine Department of Education (DepEd) has formally incorporated information and communications technology (ICT) into the Grade 10 curriculum. Department of Education Order No. 78, Series 2009 section 3, said that the school shall serve as the ICT's regional training and assessment centers. This further means they shall serve as the technical support system of other Tech-Voc high schools and other general high schools.

The study was conducted at President Quirino National High School since this school was a third of the largest high school in the Department of Education, Division of Sultan Kudarat, consisting of 2,179 enrollees.

Technology and Livelihood Education (TLE) specialized in Information in Communication Technology (ICT) (DepEd LIS, 2024). The number of students in this specialization was greater as compared to other specializations like Electrical Installation and Management (EIM) and Cookery. After they completed their grade 10 level, students started to manifest hesitance in continuing to ICT strand.

The map of President Quirino National High School, Sultan Kudarat, Region 12, Socsargen where Experimental group and Control group were separated presented in Figure 2 below.

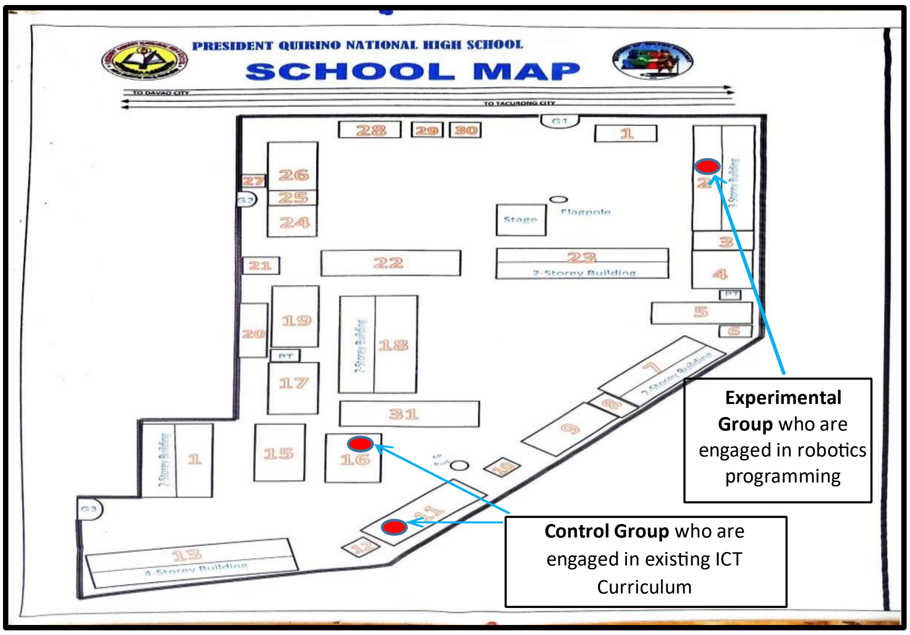

Figure 2. Map of President Quirino National High School (PQNHS)

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Source: School Planning Administration

Respondents of the Study

The Department of Education (DepEd) had been actively promoting robotics education among Grade 10 ICT students as part of its curriculum enhancements. Robotics engaged students in Science, Technology, Engineering, and Mathematics (STEM) fields, providing them with foundational knowledge and skills relevant to modern technological advancements. The curriculum included a structured approach through various lessons that cover essential concepts of robotics technology, encouraging hands-on learning experiences that foster creativity and problem-solving abilities (Department of Education, 2020). This initiative seeks to improve students' digital literacy by adding ICT skills to the K–12 curriculum, such as robotics programming and multimedia concepts centered on video editing and graphics design for Grades 8–10. The program also gives educators the resources and instruction they need to create successful ICT-assisted learning environments (Department of Education, 2022).

The respondents of the study were taken from grade 10 students in the TLE-ICT section or specialization. There were three sections of students under the Junior high school taking TLE-ICT in grade 9 and three sections also in grade 10. The focus of this study was grade 10 since the students were on their last exit going up to Senior high school and deciding on other strands they like to pursue like EIM, STEM, Humanities and Social Science (HUMSS), and Bread and Pastry (BPP). In the three sections of the ICT, students were separated into two groups only. First group served as an experimental group, where their interest was evaluated before and after they were engaged in the robotics programming tasks or activities. The second group served as a control group that was not engaged in robotics programming activity, meaning they were taught regular lessons from existing ICT curriculum. Their interest in ICT was also evaluated.

The total population of respondents is presented in Table 1 below.

Table 1. Target respondents per section.

Grade 10 TLE-ICT Sections	**Number of Students**		***TOTAL***
	MALE	**FEMALE**	
10-Aristotle	16	42	*58*
10-Pythagoras	22	40	*62*
10-Galilie	20	39	*59*
Total	**54**	**118**	***179***

Sampling Technique

Since the recent study integrating modern technology, the online sample size calculator from Calculator.net was utilized first. To equally abstract the number of respondents per section, stratified sampling techniques were applied in this study. This sampling technique was done by dividing the population into categories or strata, which was the population per section, and getting the members at random proportionate to each stratum or sub-group, which was the number of respondents per section.

Table 2. Distribution of respondents per section

Grade 10 TLE-ICT Section	**Population**	**Percentage**	**Sample**		**Total**
			Control Group	**Experimental Group**	
10-Aristotle	58	32%	19	19	38

10-Pythagoras	62	35%	20	20	40
10-Galilie	59	33%	19	19	38
Total	**179**	**100%**	**58**	**58**	**116**

The last technique was the lottery method to have pair selections of respondents per section. To ensure that no one was overlooked, the master list of students was collected in every classroom. All selected students were requested to complete answering the questionnaires. This method offered comprehensive and highly accurate insights, as the data represented the entire population, eliminating any sampling error. The researcher ensured that the findings reflected the entire study, provided reliable and complete data to answer the objectives of this study.

Research Instrument

A researcher-made research instrument was used in this study to seek answers on the level of students' interest in ICT and their level of engagement in robotics programming. This research instrument undergone in the validation of the experts before it was employed to ensure that the research questions were answered accurately and that all contents were readable, understandable to the respondents.

There were two parts of the research instrument used in this study. Part I evaluated the level of students' interest in ICT for both the control group and experimental group before any given instructions or teachings, which served as their pre-evaluation or pre-test. After certain instructions or teaching to both groups, their interest in ICT was evaluated again using Part I of the research instrument, which served as their post-test. Part II evaluated the level of students' engagement in robotics programming activities for the experimental group only. Further elaborations, the control group was instructed to answer only Part I of the research instrument since they were not engaged in robotics programming activity. On the other hand, the experimental group was instructed to answer Part I and Part II of the research instrument.

The respondents rated all the questions using the 5-Point Likert Scale with its verbal descriptions and interpretations in Table 3 below.

Table 3. 5-Point Likert Scale and Interpretations for Students' Responses

Rating	Verbal Descriptions	Interpretation
5	Strongly Agree (SA)	I **strongly agree** with the given statement.
4	Agree (A)	I **agree** with the given statement.
3	Neither Agree nor Disagree (N)	I **neither agree nor disagree** with the given statement.
2	Disagree (D)	I **disagree** with the given statement.
1	Strongly Disagree (SD)	I **strongly disagree** with the given statement.

Data Gathering Procedure

The certification of panelists to be the proof of critiquing and checking of the manuscript, and the approval and permission of the Dean of the Graduate School, were assured first. Afterwards, permission from the Schools Division Superintendent of Sultan Kudarat to conduct the experimentation on the respondents from the President Quirino National High School was requested. Along with this, permission from the school principal to administer robotics programming tasks and distribute questionnaires for the Grade 10 ICT students was also obtained.

For data gathering, this study consisted of three (3) steps. Firstly, consent letter to the respondents in both the control group and experimental group were given together with the research questionnaire, which served as their pre-test. They were not told that some of them were engaging in robotics programming to ensure that their

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responses were not influenced by the introduced robotics lessons. Their responses were held considering the data privacy for their protection.

Secondly, after they were done answering, the experimental group was sent to the computer laboratory to do robotics programming activities instructing them to follow and observe safety protocols inside computer laboratory. Using the simulated robotics parts in the platform of Tinkercad.com, they were instructed to combine and apply the robotics C++ codes to test their functionalities of every component. There were four topics that the experimental group underwent, such as the Tinkercad account, simple LED blinking circuit, a Button-Control LED, Traffic Light Simulation, and LCD "Hello, World!." Since the respondents were large in number and the available computers in the laboratory were limited, each lesson was given a time frame of about one (1) week each to cater to all participants and a total of one (1) month engagement in robotics programming activities.

For the control group, they were exposed to former and regular topics prepared and taught by the ICT teachers from the existing ICT curriculum. They were undergone and taught regular lessons like Set Network Configuration, Install Network Cables, Wi-Fi Setup, and Router Configuration. The time frame or duration to be included in the lessons of the control group was parallel to the given schedule of the 4th quarter ICT lessons.

Thirdly, after the experimental group was done with the robotics programming activities, they were given another set of research questionnaires consisting of two parts, which served as their post-evaluation or post-test. Part I was about their interest in learning ICT, which was compared to the results of the previous responses from their pre-test. Part II was about their engagement in robotics programming activities. Since the Control group was not sent to the laboratory to do programming activities, their interest in the ICT subject was also evaluated using part I of the research instrument, which served as their post-test.

Afterwards, the data of the interest of experimental group students from the pre-test was compared to the data of their interest from their post-test using a specified and appropriate statistical tool, such as a t-test, to see if there were differences or similarities. The same was done with the control group, wherein their interest in ICT that was evaluated before regular lessons (pre-test) was also compared to the data taken from their post evaluation or post-test to see if there were differences or similarities.

Lastly, the interests of the experimental group and the control group, which were measured from their post-evaluation or post-test, were treated and analyzed using a t-test to see if there was a significant difference between the students who were engaged in the robotics programming activities and the students who were not engaged in the robotics programming activities.

Finally, the data of engagement in robotics programming and the data of interest in ICT of the experimental group were correlated through Pearson r to see if the engagement of students in robotics programming can enhance their interest in ICT education.

The procedures of collecting data on this study can be traced starting from the beginning until the end using Figure 4. Flow of Data Gathering Procedures below.

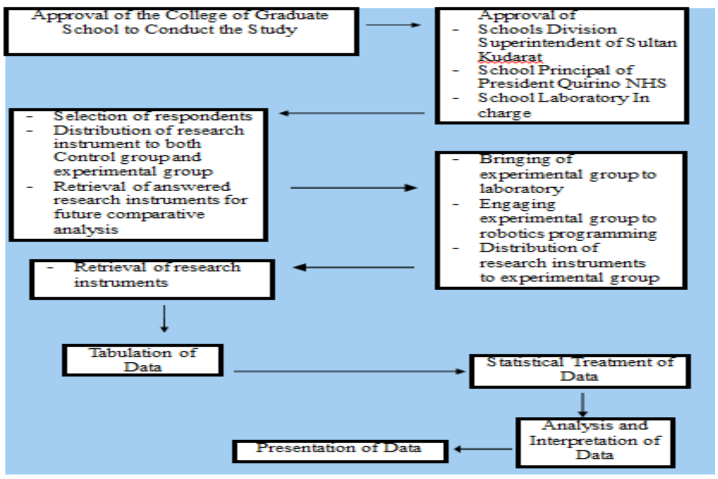

Figure 3. Flow of Data Gathering Procedures

Below is a figure of an online application on Tinkercad.com with samples of robotics parts assembled and run by the code.

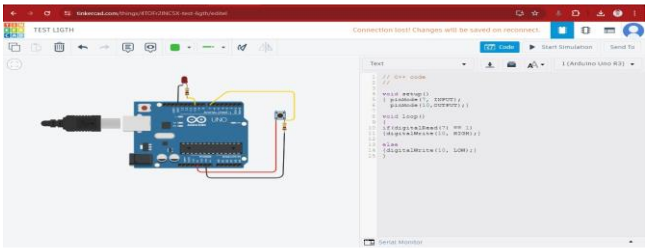

Figure 4. Robotic Parts Simulation with programmable

Statistical Treatment

Descriptive Statistics, specifically *Mean* and Standard Deviation, were utilized in this study to summarize the level of interest of students before and after the robotics programming activity stated in SOP1. Mean and Standard Deviations were also specifically applied to summarize the level of students' engagement in robotics programming stated in the SOP2.

The overall mean obtained from students' interest before and after robotics programming was interpreted using the 5-point Likert Scale in Table 4 below. This further interprets how students were extremely interested in the ICT subject.

Table 4. 5-point Likert Scale and Interpretations on Students' Interest.

Range	Students' Interest Verbal Description	Interpretation
4.20-5.00	Extremely interested	The student is **extremely interested** in ICT.
3.40-4.19	Very interested	The student is **very interested** in ICT.
2.60-3.39	Moderately interested	The student is **moderately interested** in ICT.
1.80-2.59	Slightly interested	The student is **slightly interested** in ICT.
1.00–1.79	Not at all interested	The student is **not at all interested** in ICT.

In addition, the Overall Mean that were obtained from the students' level of engagement in the robotics programming activity was interpreted using the 5-point Likert Scale in table 5 below for better and clear interpretations in the results of the current study.

Table 5. 5-point Likert Scale and Interpretations on Students' Robotics Engagement.

Range	Verbal Description	Interpretation
4.20-5.00	Very Highly	The student is **very highly** engaged in robotics programming activity.
3.40-4.19	High	The student is **highly engaged** in robotics programming activity.
2.60-3.39	Moderate	The student is **moderately engaged** in robotics programming activity.
1.80-2.59	Low	The student is **low engaged** in the robotics programming activity.
1.00–1.79	Very Low	The student is **very low engaged** in the robotics programming activity.

Inferential Statistics were also applied in this study. For SOP3, 3. Is there a significant difference in the interest in ICT education between the students who are engaged and not engaged in robotics programming? A t-test was used. For SOP 4, 4. Is there a significant difference in the level of students' interest in ICT before and after robotics programming? A t-test was also used. For SOP5. 5.Is the engagement in robotics programming capable of enhancing students' interest in the ICT subject? Correlation analysis will be helpful using specifically the Pearson correlation coefficients or Spearman's rank correlation coefficients.

These statistical tools provided identifications in the impact of engagement in robotics programming on students' interest in ICT education.

RESULTS AND DISCUSSIONS

Table 6. Level of Students' Engagement in Robotics Programming Activity under Experimental Group.

Students' engagement	***Mean***	***SD***	**Interpretation**
Active Participation	4.13	.70	High
Communication and Collaboration	4.33	.48	Very high
Technical Proficiency	3.78	.91	High
Attitudes and Emotions	4.14	.69	High
Adherence to Safety Protocols	4.49	.50	Very high
Overall Mean	**4.18**	**.46**	**High**

The results in Table 6 show that students in the experimental group were highly engaged in robotics programming, with an overall mean score of (4.18) with its standard deviation of (.46). The highest score (M=4.49, SD=.50) was for "Adherence to Safety Protocols", meaning students followed safety rules well and showed responsibility while working with robotics. This aligns with Yang et al. (2023), who found that robotics education helps students develop professionalism and responsibility.

Among the variables, "Technical Proficiency" had the lowest score of (M=3.78, SD=.91) but was still in the "High" in the range of description, suggesting that while students were learning technical skills, they might need more time to fully master robotics programming. It was also noticed that the standard deviation is higher which indicates that the other student is more skillful as compared to other as their responses showed a great spread. This is supported by Verner and Revzin (2021), who explained that hands-on experience is key to developing programming and engineering skills. Practical application of concepts reinforces theoretical knowledge and fosters deeper learning.

Table 7. Level of Students' Interest in ICT Subject before Engagement in Robotics Programming Activity under Experimental Group.

Students' interest	***Mean***	***SD***	**Interpretation**
Active Participation	3.36	.59	Moderately interested
Curiosity	3.50	.48	Very interested
Enthusiasm	3.43	.58	Very interested
Quality of Work	3.65	.58	Very interested

Initiative	3.52	.50	Very interested
Consistency	3.59	.49	Very interested
Emotional Engagement	3.58	.51	Very interested
Desire for Mastery	3.66	.45	Very interested
Overall Mean	**3.54**	**.39**	**Very interested**

Table 7 shows that before engaging in a robotics programming activity, students in the experimental group were already interested in the ICT subject, with an overall mean score of (3.54) with a standard deviation of (.39), which is described in the measurement scale as "Very Interested." The highest score was for "Desire for Mastery" of (M=3.66, SD=.45), meaning students were eager to develop their ICT skills even before being introduced to robotics. This supports Goldhammer et al.'s (2022) study, which found that students who are motivated to master a subject tend to put in more effort and stay engaged for a longer time.

However, "Active Participation" had the lowest score (M=3.36, SD=.59), described in scale as "Moderately Interested." This suggests that while students liked ICT, they were not as actively involved in classroom activities before robotics was introduced. Suryanti et al. (2021) pointed out that participation is key to better learning, and interactive lessons can help boost the engagement of the learners.

Table 8. Level of Students' Interest in the ICT Subject under the Control Group before ICT Lessons.

Students' interest	***Mean***	***SD***	**Interpretation**
Active Participation	3.58	.38	Very interested
Curiosity	3.59	.36	Very interested
Enthusiasm	3.67	.41	Very interested
Quality of Work	3.58	.52	Very interested
Initiative	3.50	.49	Very interested
Consistency	3.70	.45	Very interested
Emotional Engagement	3.66	.37	Very interested
Desire for Mastery	3.57	.49	Very interested
Overall Mean	**3.60**	**.17**	**Very interested**

The data in Table 8 shows that students in the Control group demonstrated an interest in the Information and Communication Technology (ICT) subject. The overall mean of (3.60) and standard deviation of (.17), interpreted as "Very interested," indicates that students were also interested in the subject even before without introduction of robotics programming. The highest recorded was for "Consistency" (M = 3.70, SD = 0.45). This implies that students show sustained attendance and a continuous effort to learn ICT. Bernardo (2020) highlighted that consistency in learning activities reflects intrinsic motivation, which is a crucial factor in academic success.

The lowest results (M = 3.50, SD = 0.49) among the indicators of students' interest were for "Initiative," which indicates that students were always dedicated and reminded repeatedly in the ICT tasks. Ibrahim et al. (2022)

noted that student initiative is an essential trait in fostering engagement and independent learning, particularly in ICT education.

Table 9. Level of Students' Interest in ICT Subject after Engagement in Robotics Programming Activity under Experimental Group.

Students' interest	*Mean*	*SD*	Interpretation
Active Participation	4.33	.60	Extremely interested
Curiosity	4.39	.51	Extremely interested
Enthusiasm	4.26	.57	Extremely interested
Quality of Work	4.46	.48	Extremely interested
Initiative	4.21	.65	Extremely interested
Consistency	4.29	.67	Extremely interested
Emotional Engagement	4.20	.53	Extremely interested
Desire for Mastery	4.33	.59	Extremely interested
Overall Mean	**4.31**	**.40**	**Extremely interested**

The results in Table 9 show that after engaging in robotics programming, students' interest in ICT increased, with an overall mean score of (M=4.31, SD=.40), classified as "Extremely Interested." Every indicator improved, with the highest score for "Quality of Work" of (M=4.46, SD=.48), meaning students became more dedicated to producing better outputs. This supports Cruz and Reyes (2022), who found that students who are more interested in a subject tend to put more effort into their work.

A big improvement was seen in "Active Participation" with its score of (M=4.33, SD=.60), which was previously the lowest score (M=3.36, SD=.59) in Table 8.

This shows that students became more engaged in ICT after hands-on robotics programming activity, supporting Suryanti et al. (2021), who found that interactive and hands-on learning helps students want to get more involved.

Table 10. Level of Students' Interest in the ICT Subject under the Control Group after ICT Lessons.

Students' interest	*Mean*	*SD*	Interpretation
Active Participation	3.60	.71	Very interested
Curiosity	3.72	.69	Very interested
Enthusiasm	3.68	.74	Very interested
Quality of Work	3.63	.78	Very interested
Initiative	3.60	.69	Very interested
Consistency	3.85	.69	Very interested
Emotional Engagement	3.77	.68	Very interested

Desire for Mastery	3.67	.85	Very interested
Overall Mean	**3.69**	**.60**	**Very interested**

The summary of data presented in Table 10 shows that students in the Control group were also interested in the ICT subject after the experimentation, even without engaging them in robotics programming activity with an overall mean score of (3.69) with a standard deviation of (.60), which was described in the scale as Very interested. The highest score was gained for "Consistency" of Mean (3.85) with its standard deviation of (.69), meaning students stayed in the classroom to hopefully acquire learning in ICT. Bernardo's (2020) study mentioned that consistent involvement in learning leads to better academic performance.

The lowest score stood for "Initiative" (M=3.60, SD=.69) and "Active Participation" (M=3.60, SD=.71), but still in the "Very Interested" range of the interpretation of the scale. This was claimed that while students participated, they also explored ICT on their own.

According to Ibrahim et al. (2022), students' willingness to take initiative depends on teaching methods and the classroom setting. If the delivery of a subject or task is new, challenging, or hands-on in its way, the students try to initiate their strategy to finish with or without assistance.

Table 11. T-test Analysis between students' interest in ICT before and after robotics programming activity under the experimental group.

Interest in ICT	**Mean**	***t*-comp**	***t-critical***	***p*-vale**
Before (Pre-test)	3.54	8.019	1.981	0.000
After (Post-test)	4.31			
Difference	**0.77**			
*-significant at 5% level				

Overviewing Table 11, it shows that students' interest in ICT significantly increased after engaging in robotics programming. Before the activity, their average interest level was 3.54, described as "Very Interested", but after engaging, it rose to 4.31, described as "Extremely Interested".

The t-test results confirm further that this increase is statistically significant with its t-computed value (8.019) larger than the t-critical value (1.981) and p-value (0.000) less than 5% level of significance which suggests rejecting the null hypothesis "There is no significant difference in the level of students' interest of the experimental group in ICT before and after robotics programming". Meaning robotics had a real impact on making ICT more interesting for students.

This supports Santos (2022), who found that students who experience hands-on robotics activities are more motivated compared to those in non-robotics lessons. Similarly, Carro et al. (2021) highlighted that robotics makes learning more interactive, helping students develop a stronger interest in ICT.

Table 12. T-test Analysis between Students' Interest in ICT Before and After Instructions Under Control Group.

Interest in ICT	**Mean**	***t*-comp**	***t-critical***	***p*-vale**
Before (Pre-test)	3.60	1.021	1.981	0.309
After (Post-test)	3.69			

Difference	**0.08**			
**ns-not significant at 5% level				

The data presented in Table 12 analyzes students' interest in Information and Communication Technology (ICT) before and after an intervention in a Control group setting. The results show little increase in students' interest, with the mean score rising from 3.60 (pre-test) to 3.69 (post-test).

However, the t-test analysis indicates this difference was not statistically significant because the t-computed value (1.021) was less than (1.981) and the p-value (0.309) greater than 5% level of significance which suggests accepting the null hypothesis "There is no significant difference in the level of students' interest of the experimental group in ICT before and after robotics programming". Since the learners were not engaged in robotics programming, their interest in ICT was not increased statistically.

This aligns with the findings of Carro, Sancristobal, and Plaza (2021), who emphasized that engaging students in practical, hands-on activities such as robotics can enhance their interest in ICT.

Table 13. T-test Analysis between students' interest in ICT between the students who are engaged and not engaged in robotics programming.

Participants	**Mean**	***t*-comp**	***t-critical***	***p*-vale**
Control Group	3.69	6.572	1.981	0.000
Experimental Group	4.31			
Difference	**0.62**			
*-significant at 5% level				

The results in Table 13 show that students who engaged in robotics programming were significantly more interested in ICT than those who did not. The experimental group, which participated in robotics activities, had a mean score of 4.31 ("Extremely Interested"), while the Control group had a lower mean score of 3.69 ("Very Interested").

The t-test results with a t-computed value (6.572) greater than the t-critical value (1.981) and p-value (0.000) less than 5% level of significance which rejects null hypothesis "There is no significant difference in the interest in ICT education between the students who are engaged and not engaged in robotics programming", meaning robotics had a real impact on increasing student interest. This supports Santos (2022), who found that hands-on robotics activities make ICT subjects more exciting and engaging compared to traditional teaching methods.

The results also align with Garcia and Rodriguez (2021), who discovered that robotics programming sparks curiosity and encourages students to be more engaged in their learning. Tan and Lim (2022) further explained that robotics helps students develop computational thinking skills, which strengthens their interest in ICT subjects. These findings suggest that adding robotics to ICT education can make learning more exciting and interactive, leading to greater student engagement and participation.

Table 14. Correlation Analysis between Students' Engagement in Robotics Programming and Interest in ICT Subject.

Variables	***r***	***t*-comp**	***t*-critical**	***p-value***
Engagement in Robotics Programming	0.741	8.258	1.981	0.000

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Interest in ICT				
*-significant at 5% level				

As stated in Table 14, it was found that there was a strong connection between students' engagement in robotics programming and their interest in ICT, with a correlation of (0.741). This means that as students get more involved in robotics activities, their interest in ICT also grows. The t-test results, such as the t-computed value of (8.258), which is greater than the t-critical value of (1.981), confirm that this relationship is statistically significant at 5% (alpha 0.05), which is also greater than the p-value (0.000), which indicates that robotics can increase students' interest in ICT.

This supports Santos (2022), who found that students who participate in robotics programming show higher motivation for ICT compared to those in traditional lessons. Similarly, Carro et al. (2021) highlighted that hands-on robotics activities make learning more engaging and interactive. These results highlight also the importance of interactive learning. Robotics actively involves students in the learning process, increasing participation and motivation, as Verner et al. (2022) found. This study strongly suggests that adding robotics to the ICT curriculum can make learning more fun and engaging. By doing so, educators can help students develop technical skills and a passion for ICT, better preparing them for future careers in technology and STEM fields.

SUMMARY OF FINDINGS

Automation eases human effort through robotics in everyday systems and devices. Robotics has indeed revolutionized human civilization by enhancing efficiency, convenience, and productivity across multiple sectors. This study explored the utilization of robotics by engaging students in hands-on programming to enhance their interest in ICT. Using a True experimental research design, the study was conducted among grade 10 students in the TLE-ICT section at President Quirino National High School. The findings show that:

Students in both the Control and experimental groups were already interested in ICT but at different levels. Those who engaged in robotics programming showed a significant increase in their enthusiasm and participation. Before robotics, the experimental group had a "Very Interested" rating in ICT, with an overall mean of 3.54. However, after engaging in robotics activities, their interest level increased to "Extremely Interested," with a mean of 4.31.

The t-test outcomes confirm further that this increase is statistically significant with its result of t-computed value (8.019) and p-value (0.000) less than 5% level of significance, meaning robotics had a real impact on making ICT more interesting for students. Students who participated in robotics also displayed high engagement, particularly in communication and collaboration, technical proficiency, and adherence to safety protocols. Among the key improvements, "Active Participation" and "Curiosity" increased significantly, showing that hands-on learning helped students become more involved and eager to explore ICT concepts.

Furthermore, a strong correlation (r = 0.741) with its t-computed value (8.258) and p-value (0.000) was found between robotics engagement and ICT interest, proving that the more students are engaged in robotics, the more they develop an interest in ICT. These findings also confirm that the robotics programming activity given to the students was effective in making learning more interactive, enjoyable, and meaningful.

CONCLUSIONS

Based on the results of the study, the following conclusions are drawn:

Robotics programming plays a vital role in enhancing students' interest and engagement in ICT. Before engaging in robotics, students already had a high interest in ICT, but after hands-on robotics activities, their enthusiasm and participation significantly increased to an extremely high. Robotics not only made ICT lessons more exciting but also fostered engagement and interactivity, making learning more effective.

These findings align with previous research showing that real-world applications of ICT concepts, such as robotics, improve student motivation and learning outcomes. The study highlights that experiential learning methods, where students actively participate which significantly enhance engagement and long-term interest in ICT subjects rather than passively receiving information. Thus, incorporating robotics into ICT education can help prepare students for future careers in technology and STEM fields.

RECOMMENDATIONS

Based on these findings, the study strongly recommends the following:

1. It suggested that robotics programming be integrated into ICT education at different levels to prepare students for future technology and make teaching-learning more interactive and enjoyable.

2. Schools may adopt robotics-based learning activities to make ICT subjects more engaging and applicable to real-world scenarios. Also, schools may invest in robotics kits, programming tools, and learning resources to provide students with hands-on learning experiences.

3. Teachers may receive training on how to effectively facilitate robotics education to maximize student learning outcomes.

4. All Educators can continuously apply interactive and experiential learning strategies like robotics programming activities to sustain student interest and motivation.

5. Educational institutions may collaborate with technology organizations to provide students with opportunities to participate in robotics competitions and real-world projects, helping them apply their learning in practical settings and inspiring future careers in technology.

Further research may explore the long-term effects of robotics on students' ICT skills and career choices.

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