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Evaluation of Robotics Education Program among Private Secondary Schools in Region IV-A CALABARZON

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Abstract

This study evaluated the implementation status of the Robotics Education Program among private secondary schools in Region IV-A CALABARZON and developed inputs for a program improvement plan. Guided by the CIPP (Context, Input, Process, Product) evaluation model, a descriptive evaluation research design and quantitative approach were used. Data were gathered from 130 robotics teacher-respondents from 40 selected private secondary schools in Cavite, Laguna, Batangas, and Rizal through a validated and reliability-tested researcher-made questionnaire. Data analysis employed frequency, percentage, and weighted mean, and examined group differences using Mann–Whitney U and Kruskal–Wallis tests. Results indicated that curriculum implementation was rated to a very large extent, while learning outcomes were rated to a large extent, with robotics perceived to strengthen critical thinking and problem-solving. Support services for professional development were generally utilized to a large extent, and teachers were very much interested in further training, particularly on robotics pedagogy and programming. Required robotics technologies were rated adequate overall, and access to electronic learning resources and common communication/programming tools was high. The leading implementation challenges were limited internet bandwidth, inadequate teacher robotics knowledge, and ICT network deficiencies. The study concluded that strengthening teacher capability and resourcing is necessary and recommended increased professional development, adequate budgeting for tools and licenses, stronger provider partnerships, broader participation opportunities, and potential integration into the national basic education curriculum. The study aligns with SDG 4 (Quality Education) and SDG 9 (Industry, Innovation and Infrastructure) by supporting evidence-based improvement of technology-enabled learning. Sustainability impact centers on educational and digital sustainability through strengthened capacity, infrastructure readiness, and institutional support for long-term program continuity.

Keywords: CIPP model; curriculum implementation; educational robotics; learning outcomes; private secondary schools; professional development; Robotics Education Program; training and development needs; technology-based learning resources

1. Introduction

Technology has reshaped education by expanding access and changing teacher–student roles, pushing schools to continuously (re)design instructional programs aligned with 21st-century workforce demands (Ezhova, 2021). In this context, robotics education has gained strong interest as a tool for developing learners' cognitive, social, and interdisciplinary competencies (Alimisis, 2013), yet its benefits depend less on the platform and more on the quality of curriculum design, implementation conditions, and systematic evaluation. Anchored on this need, the study evaluates the Robotics Education Program implementation among private secondary schools in Region IV-A CALABARZON and uses the results to inform a proposed improvement plan.

Technology has driven major changes in educational delivery and curriculum development, requiring intensive research to ensure instructional programs remain responsive to evolving societal needs (Ezhova, 2021). Robotics education has emerged as a prominent innovation in this shift, attracting educators and researchers for its potential to develop learners' cognitive and social skills and support interdisciplinary learning in STEM, ICT, and other curriculum areas (Alimisis, 2013). However, robotics education is not a guaranteed solution by mere adoption; the effectiveness of robotics-based learning depends on how the curriculum is implemented and aligned with sound educational philosophies and learning environments, making program assessment essential before scaling or institutionalizing robotics offerings.

Educational robotics is presented as an interdisciplinary learning field that uses robots and electronic components to support hands-on, constructivist learning and improved participation and performance (Telefonica.com, 2023). Because definitions and implementations vary internationally, ER is framed through categories such as learning robotics, learning by robotics, and learning with robotics (Scaradozzi et al. (2019); Gaudiello and Zibetti (2016)), and as activity systems that use robots and related artifacts to improve learning experiences across levels (Angel-Fernandez and Vincze, 2018; Jung & Won, 2018). ER is consistently linked with 21st-century skills and STEM readiness, including collaboration and problem solving (Benitti & Spolaôr, 2017; Nemiro, 2020; Scaradozzi et al., 2015), problem-solving growth (Eguchi, 2017), and creativity development, including framework-based support for creativity in ER tasks (Yang, et al., 2020; Yang et al. (2020)). The literature also situates educational robotics historically and technologically, tracing developments from early educational robots to modern platforms and kits (Pan, 2023) and highlighting the expansion of K-12 robotics through tools and movements tied to programmable languages and modular systems (Anwar et.al, 2019; Anwar, S., Bascou, N. A., Menekse, M., & Kardgar, A. ,2019). Robotics is further described as beneficial for workforce preparation, inclusive learning, teamwork, and communication (Space Foundation Editorial Team (2023)), including club-based and competition-supported skill development (Byrone, 2021) and after-school STEM activities demonstrating learning gains and broader participation outcomes (Sahin and colleagues' (2014)). On curriculum and implementation, robotics is framed as increasingly necessary for education systems facing rapid technological change and Industry 4.0 pressures, requiring curriculum adaptation, teacher capability-building, and appropriate learning resources (Khanlari, 2013; Nell (2016)). Teacher practice and technology acceptance remain pivotal; evidence shows robotics is often used for competitions rather than integrated classroom learning and that teachers still report needing additional training and resources after professional development initiatives (Ali, N. et al (2023)). Further, robotics curriculum evaluation is linked to computational thinking and motivation (García-Penalvo, Reimann, Tuul, Rees, & Jormanainen, 2016), shared language and communication between teachers and learners (Fernandes et al., 2018), and digital literacy framing through Bloom's-aligned models (Phuapan et al., 2016). Finally, the literature consistently identifies implementation constraints—funding, access, curriculum integration, teacher readiness, evaluation tools, and inclusivity—requiring systematic support and partnerships (Khanlari (2014); (Lliescu, 2023); Naval (2019); Lee (2014); Addas,(2019); (Maker's muse, 2023)).

In the Philippine context, robotics education is implemented in some public and private schools through coordination with providers, but it is still not widely used compared with other countries, and it is not yet embedded as a standard component of the Philippine K-12 Curriculum, leaving questions about effectiveness, necessity, and scalability. This gap is reinforced by national-level discussions on strengthening technology integration and considering robotics in academic and vocational preparation, including calls for facilities, teacher upskilling, and structured training opportunities (Esportuno and Gerardo, 2014). Globally, the urgency for robotics- and STEM-aligned education is tied to rapid technological advancement and projected labor-market shifts, where emerging technologies reshape skill requirements and automation pressures raise concerns about job displacement and workforce transitions (World Economic Forum, 2016; The International Labour Organization (2016)). These trends intensify the need for evidence-based robotics program design, evaluation, and policy decisions that ensure schools develop relevant competencies, broaden access, and maintain curriculum responsiveness.

The study is anchored on Stufflebeam's CIPP (Context, Input, Process, and Product) evaluation model, positioned as a systematic framework for guiding program conceptualization, implementation, and continuous improvement through evidence-based feedback and judgments of effectiveness (Aziz et.al, 2018). The model structures evaluation into: (1) Context evaluation (needs, goals, readiness, and problem diagnosis), (2) Input evaluation (strategies, resources, capabilities, and plans), (3) Process evaluation (monitoring and implementation documentation), and (4) Product evaluation (outcomes, merit, and significance). Consistent with the CIPP curriculum evaluation model of Stufflebeam, (2003), the study frames robotics education implementation as a program that must be evaluated not only on intended learning outcomes but also on support services, teacher professional development, training and development needs, and adequacy/access of technology-based resources to ensure a coherent improvement plan grounded in implementation realities.

Although robotics education is widely framed as beneficial for interdisciplinary learning, 21st-century skills development, and STEM engagement, the literature repeatedly emphasizes that outcomes are not guaranteed by adoption alone; effectiveness depends on curriculum integration, teacher readiness, resource sufficiency, and evaluation methods that can credibly capture learning and implementation quality. This gap becomes more pronounced where robotics remains unevenly adopted and insufficiently institutionalized, especially in contexts where schools rely on external providers, face access and affordability constraints, and experience persistent teacher training demands (Khanlari (2014); (Lliescu, 2023); Ali, N. et al (2023)). The rationale for the present study is therefore grounded on the need to evaluate how robotics education is actually implemented in private secondary schools in Region IV-A CALABARZON—covering curriculum implementation and learning outcomes, support services utilization, professional development and training needs, provision of required resources, and access/use of technology-based learning resources—while also identifying implementation challenges and consolidating respondent-proposed solutions into a feasible improvement plan. The study is further reinforced by documented concerns that training programs may be short, under-theorized, or inconsistently grounded in learning theories, and by evidence of persistent gender-related differences in STEM attitudes within robotics education settings, which require continued research and program refinement (Despoina, et.al., 2020; Despoina, (2020); (Wassenaer, Tolboom and Beekum, 2023); Mallik, Rajguru, and Kapila (2018)).

The study aligns most directly with SDG 4 – Quality Education through its focus on evaluating and improving technology-enabled learning programs that build relevant competencies and strengthen instructional delivery. It supports SDG 9 – Industry, Innovation and Infrastructure by addressing how schools can develop and sustain innovation-oriented learning environments, including access to robotics technologies, learning resources, and digital capability-building. The emphasis on preparing learners for evolving workforce demands links to SDG 8 – Decent Work and Economic Growth, particularly through competencies tied to STEM readiness, computational thinking, and workplace-relevant skills. Given documented concerns on inclusivity and gender differences in STEM-related attitudes in robotics contexts, the study also supports SDG 5 – Gender Equality by reinforcing the need for equitable participation and targeted strategies that broaden engagement. Finally, because implementation improvements emphasize collaboration with providers, community support, and partnerships for resources and capacity-building, the study is consistent with SDG 17 – Partnerships for the Goals.

The study contributes to educational sustainability by strengthening evidence-based program evaluation and continuous improvement processes for robotics education, helping schools maintain curriculum relevance amid rapid technological change. It supports technological and digital sustainability by focusing on the conditions required for effective robotics implementation—teacher competencies, learning resources, access, and infrastructure—so that technology integration is not episodic but institutionally supported. It also contributes to socio-economic sustainability by linking robotics-enabled learning with the development of skills viewed as essential for future work and innovation-oriented participation, while addressing barriers that can widen opportunity gaps if left unmanaged. Lastly, it advances institutional and community sustainability by emphasizing systematic evaluation (via CIPP), stakeholder feedback, and partnership-driven solutions that enable schools to sustain robotics education programs beyond isolated activities or competitions.

2. Materials and methods

2.1 Research Design

The study used a descriptive evaluation research design and quantitative research method to determine the current status of the Robotics Education Program implementation among private secondary schools in Region IV-A CALABARZON. Descriptive evaluation studies were described as approaches that portray existing conditions and contextualize findings within the program's implementation environment, providing accurate descriptions of programs, activities, processes, and persons (Ravenscroft, J. and Allison, P., 2018). Consistent with this, descriptive research was defined as a method focused on describing characteristics of a population or phenomenon—emphasizing the "what" rather than the "why"—and used to define respondent characteristics, measure trends, compare groups, validate existing conditions, and conduct research across different times (Majunatha. N. (2019)).

2.2 Research Setting

The study was conducted in Region IV-A CALABARZON and focused on private secondary schools implementing a robotics education program. Schools were identified across Cavite, Laguna, Batangas, and Rizal; there were no recorded schools from the provider's database in Quezon implementing or offering the Robotics Education program at the time of the study. The investigation also covered schools implementing the robotics education program during the last five (5) academic years in the region.

2.3 Respondents

The respondents were teachers from private secondary schools in Region IV-A CALABARZON who were currently teaching Robotics Education Program or had experience facilitating the program. A total of 130 teacher-responses were gathered, with respondents coming from the selected private secondary schools in Cavite, Laguna, Batangas, and Rizal. Stratified random sampling was used to select teacher-respondents, with respondents divided based on provincial location and selected through proportionate stratified random sampling from participating schools. The study also described stratified random sampling as a method that divides a population into strata (subgroups), also referred to as proportional random sampling or quota random sampling. To determine sample size, the Cochran formula was used, guided by the explanation that it estimates an ideal sample size given precision, confidence level, and estimated population proportion, with a correction factor for small populations of known size (Glen, 2023). The study identified 160 secondary private schools offering Robotics Education in Region IV-A CALABARZON and randomly selected 40 schools, with an estimated 175 robotics teachers in Cavite, Laguna, Batangas, and Rizal. The computed appropriate sample size was reported as 121, and the data gathering retrieved 130 responses.

2.4 Research Instruments

A structured researcher-made questionnaire was used. It was developed through review of course materials on curriculum, Learning Outcomes, support services, teacher qualifications, and course modules on robotics education program. The questionnaire included a part on the demographic profile of teacher respondents (e.g., sex, age, civil status, highest educational attainment, teaching experience in robotics, and number of relevant trainings/seminars attended), a part assessing implementation status in terms of curriculum evaluation and Learning Outcomes, and a part covering support services (professional development, training and development needs, and provision of required resources to support effective learning). The instrument used five-point rating scales for implementation-related indicators (e.g., "To a very large extent" to "Not at all"), for training and development interest (e.g., "Very much interested" to "Not interested"), and for adequacy of required resources (e.g., "Very adequate" to "None at all"), including appraisals related to access and use of technology-based learning resources. The instrument also included items on challenges encountered in program implementation and open-ended questions eliciting recommended solutions from respondents. For instrument quality, validation was conducted by five (5) experts from institutions and companies involved in robotics education program implementation. Expert comments were incorporated into the final instrument, which was then revised and subjected to reliability testing, with results reported as "Excellent" using Cronbach's Alpha and computed using SPSS (Statistical Package for the Social Sciences).

2.5 Data Collection

After developing the instrument and completing required processes, the researcher sought permission from school administrators of the selected private secondary schools in Region IV-A CALABARZON and from the third-party provider to conduct the survey among target participants in each respondent school. To protect respondent privacy and in accordance with RA 10173 or the Data Privacy Act of 2012, respondent names were not mandated in the instrument. Data were collected through two modes: onsite face-to-face administration and online data gathering via google forms, depending on respondents' preference and convenience.

2.6 Data Analysis

Data were organized and collated manually and electronically to enable application of statistical measures. Descriptive statistics included frequency distribution and percentage to summarize responses, while weighted mean was used to quantify responses and derive corresponding verbal interpretations. For inferential analysis, the study used non-parametric tests to examine differences in evaluations when respondents were grouped by profile variables. The Mann Whitney U-test was used to compare evaluations between two independent groups, specifically by sex and civil status. The Kruskal Wallis test H-test was used to compare evaluations across more than two independent groups, specifically by age, highest educational attainment, secondary level of teaching experience, number of years teaching robotics education, and number of relevant training/seminars attended.

3. Results and Discussion

3.1. Demographic Profile of Teacher-Respondents

3.1.1 Sex

The respondents were predominantly male, with 77 respondents (59.2%) compared with 53 female respondents (40.8%). This distribution indicates that robotics education classes in the participating schools were more commonly handled by male teachers based on the obtained respondent profile.

3.1.2 Age

Most respondents were between 26 to 30 years old (52; 40%), followed by 20 to 25 years old (34; 26.2%), 31 to 35 years old (25; 19.2%), 36 to 40 years old (11; 8.5%), and 41 years old and above (8; 6.2%). This indicates a similarity with the result of the study of Ali, N. et al (2023) where majority of teachers handling robotics classes belongs to ages between 26-35 years old and there are few teachers handling robotics classes with the age range of 40 and above. Teachers aged 26-35 years old most likely belong to the Millennial generations where they are considering themselves as digital natives wherein part of their characteristics is they are capable of using modern technology proficiently according to Gilis (2020).

3.1.3 Civil Status

The respondents were almost evenly distributed by civil status, with 71 respondents (54.6%) single and 59 respondents (45.4%) married. This profile suggests that the robotics teacher group included both early-career and more established teachers, indicating variability in personal circumstances but without implying differences in program evaluation unless supported by subsequent results.

3.1.4 Highest Educational Attainment

Most respondents held a Bachelor's Degree (71; 54.6%), followed by Master's Degree holders (46; 35.4%), while 13 respondents (10.0%) reported other courses in ICT. This indicates that robotics education in the participating private secondary schools was largely implemented by teachers with undergraduate qualifications, with a substantial minority having graduate-level preparation and a smaller group with other ICT-related training backgrounds.

3.1.5 Highest Educational Attainment

More respondents taught both Junior High School and Senior High School (57; 43.8%) than those teaching only Junior High School (46; 35.4%) or only Senior High School (27; 20.8%). This distribution suggests that robotics teachers in the sample frequently handled the program across levels, which may affect how curriculum sequencing and learning outcomes are operationalized in both junior and senior high contexts.

3.1.6 No. of Years Teaching Robotics Education

Most respondents had 1 to 5 years of robotics teaching experience (72; 55.4%), followed by 6 to 10 years (48; 36.9%), with only 10 respondents (7.7%) reporting 11 years and above. The results indicate that robotics education teaching, within the participating schools, was largely handled by teachers with relatively short to moderate experience in robotics instruction, reflecting a developing implementation base rather than a long-established specialization.

3.1.7 No. of Relevant Trainings/Seminars Attended

A majority of respondents attended 1 to 5 relevant trainings/seminars (74; 56.9%), followed by 6 to 10 (45; 34.6%), and 11 and above (11; 8.5%). Consistent with the study's demographic synthesis, most teachers had limited but present exposure to relevant trainings, while only a small portion reported more extensive training backgrounds in Robotics Education.

3.2. Status of Robotics Education Program Implementation

3.2.1 Curriculum Implementation and Learning Outcomes

The respondents assessed curriculum implementation to a "Very Large Extent," with the creation of robotics syllabus/es identified as the highest-rated aspect among the curriculum implementation indicators. They also reported "very large extent" implementation across key instructional components such as demonstration and laboratory exercises, logical sequencing of lessons, availability and use of robotics kits and instructional tools, hands-on balance between theory and practice, alignment of activities to learning outcomes, adequacy of learning objectives, relevance of references, and appropriate lesson difficulty. For learning outcomes, respondents reported implementation to a "large extent," with "Robotics enhances critical thinking and problem-solving skills" obtaining the highest mean among learning outcomes statements. In summary, the findings indicate that the respondents have implemented the robotics education program to a large extent, particularly concerning curriculum Learning Outcomes. This is supported by the article of Abubo. J (2018), where he mentioned that study of robotics enhances 21st Century skills which involves the 4Cs namely Critical Thinking, Creativity, Communication and Collaboration.

3.3. Support Services Program Utilization

3.3.1 Professional Development of Personnel and Teachers

The extent of support service utilization for professional development showed four items rated to a very high level of use, with "Teachers use computer-based multimedia presentations in the classroom" receiving the highest mean score. At the same time, "Computers are regularly updated" received the lowest average score, but still fell within "To a large extent," indicating that some professional development-related supports were not fully utilized. Overall, the results indicate widespread utilization of professional development supports that directly enable classroom instruction and learning technology use, while infrastructure updating appears comparatively less emphasized, suggesting a practical focus on immediate instructional enablement over routine technology refresh cycles.

3.3.2 Training and Development Needs

Across the training and development items, respondents in general rated all statements "Very much interested," with "Teaching strategies and pedagogies in robotics" receiving the highest mean score, while "Evaluation and evaluation of the robotics education training program" obtained the lowest mean score. The training courses that generated high interest included Teaching strategies and pedagogies in robotics, Coding and Programming, Basic computer troubleshooting and maintenance for various robotics platforms, Artificial Technology (AI) and other tools for teaching robotics, and Advanced Robotics Control Courses utilizing Computer Programming. This coincides with the evaluation of Mallik A. et.al (2018) as they analyzed the effects of robotics training workshop on Self -Efficacy of High School Teachers, concluding that professional development activities supported teachers in developing basic skills needed in teaching robotics for secondary level students such as teaching pedagogies, coding and troubleshooting.

3.4. Provision of Required Resources and Access to Learning Platforms

3.4.1 Adequacy of Robotics Education Based Technologies

Overall, adequacy of robotics education technologies as required resources to support effective learning was rated "Adequate," with Computer Programming Platforms identified as the aspect with the highest obtained mean score among the listed areas. The detailed ratings showed Computer Programming Platforms (4.33) as "Very adequate," along with Operating Systems (4.24), Digital Circuits (4.24), and Electronic Tools (4.21), while other listed areas were generally rated "Adequate," producing a grand mean of 4.18 ("Adequate"). These results indicate that schools were generally equipped with the core technologies and foundational technical components needed for robotics teaching, but with variation across specific technology domains, implying room to strengthen resource completeness and balance across the robotics technology ecosystem.

3.4.2 Access and Use of Robotics Education Platforms and Learning Resources

In terms of access and use of robotics education platforms and learning resources, respondents rated electronic resources (e-books, e-library, digital content modules), communication tools such as E-mail and Facebook Messenger, video conferencing, and programming languages such as C, Java, and HTML at a "very large extent," with Electronic Resources obtaining the highest mean score. In contrast, "Art application" was rated "To a Large Extent." The pattern suggests that the program's implementation was strongly supported by digital content access, communication-enabled learning interactions, and programming tools, while some supplementary applications were used less extensively, indicating differentiated integration of platforms depending on perceived instructional necessity.

3.5. Differences in Evaluation When Grouped by Respondent Profile

3.5.1 Curriculum Implementation and Learning Outcomes

There was a significant difference in curriculum implementation evaluation when respondents were grouped according to Secondary Level of Teaching Experience. There was also a significant difference in learning outcomes evaluation when respondents were grouped according to Civil Status. However, there was no significant difference in the evaluation of curriculum and learning outcomes when respondents were grouped in terms of Sex, Age, Highest Educational Attainment, Number of years of Teaching Experience, and Number of Trainings/Seminars Attended.

3.5.2 Support Services Program Utilization

For support services utilization, there was a significant difference in Integration and Utilization in Teaching when respondents were grouped according to Sex, Age, Secondary Level of Teaching Experience, and Number of Relevant Trainings/Seminars Attended. There was also a significant difference in Training and Development Needs when respondents were grouped in terms of Civil Status and Highest Educational Attainment, while there was no significant difference when grouped according to the Number of Years of Teaching Robotics Experience.

3.5.3 Provision of Required Resources and Access/Use of Learning Resources

In terms of provision of required resources and access/use of technology-based learning resources, the findings revealed a significant difference on the evaluation of respondents in the Access and Uses of Technology-based Education Learning Resources in terms of Highest Educational Attainment, while the rest of the profile variables showed no significant difference. This suggests that resource access and utilization perceptions were generally consistent across most respondent profile groups, except where differences emerged based on educational attainment, indicating that training background may influence how teachers evaluate or leverage technology-based learning resources.

3.6 Differences in Evaluation When Grouped by Respondent Profile

The top three challenges encountered by teacher respondents in implementing the Robotics Education Program in private secondary schools in CALABARZON were School Internet bandwidth, Inadequate Knowledge among Teachers in Robotics, and Deficiencies in school ICT network services. The least-cited challenges were Less personal supervision from administrators and School policies and guidelines are not clear. These findings indicate that the primary barriers were infrastructure- and capacity-related, emphasizing that effective robotics instruction requires stable connectivity, functional ICT systems, and teacher competence in robotics-specific knowledge, while administrative supervision and policy clarity were comparatively less problematic in the respondent context.

3.7 Proposed Solutions to Address Identified Challenges

The respondents commonly recommended solutions focused on strengthening teacher capability and improving program support conditions, including providing training/workshops that enhance teacher knowledge and skills in teaching Robotics Education with certifications recognized nationally and internationally, allocating sufficient budget for robotics kits, computers, and necessary application licenses, drafting a well-defined curriculum aligned to needed competencies in the national curriculum, addressing school internet connectivity issues to execute lessons, updating learning spaces where robotics can be facilitated, and promoting community engagement through events, exhibits, and demonstrations showcasing student achievements. Taken together, these proposed solutions prioritize professional development, resourcing, curriculum clarity, infrastructure strengthening, learning environment improvement, and stakeholder/community support as integrated levers for improving the implementation quality of the Robotics Education Program in the participating schools.

4. Conclusion & Recommendations

The study concluded that Robotics Education classes in the covered private secondary schools in Region IV-A CALABARZON were largely handled by male teachers and that schools tended to prefer male teachers for robotics instruction; overall, there was a "Very Large Extent" need for professional development to strengthen robotics education implementation as an integrated part of school curricula. It further concluded that Robotics Education plays an important transformative role for learners, but schools must equip teachers with the necessary knowledge and competencies through robotics education training that includes basic theories and concepts of electronics, software–hardware interfacing, programming, designing, and robot assembly, alongside stronger learner access to these resources; consequently, the study emphasized the need to allocate sufficient budget and resources to improve robotics education implementation in schools.

The study recommended encouraging female teachers to venture into robotics education to promote equal opportunity and increase learners' inclination toward Robotics Education regardless of gender, while also strengthening teacher capacity through additional trainings/workshops and related professional development. It likewise recommended that schools allocate sufficient budget for materials and resources needed for robotics education, strengthen partnerships with third-party providers to collaboratively develop programs responsive to 21st-century graduate needs, and that educational leaders continue evaluative research to identify areas where teachers, students, and schools need further assistance. In addition, it recommended adopting Robotics Education at the national basic education curriculum level (integrated into the current DepEd curriculum) and suggested that future researchers examine other relevant implementation aspects or conduct in-depth studies to further improve robotics education implementation across levels and regions.

The study was limited to private secondary schools implementing a robotics education program during the last five (5) academic years in Region IV-A CALABARZON, with respondents limited to teachers who had experience teaching or facilitating robotics education in selected Junior High School and Senior High School levels. Because of the limited number of schools offering the program, schools were identified using the database/records of a Robotics Education Provider; coverage was also limited to Cavite, Laguna, Batangas, and Rizal due to no recorded schools in Quezon from the provider's database at the time, and 40 schools were identified as having implemented robotics education for at least five years.

Compliance with ethical standards

The authors declare no conflict of interest. This study followed recognized research ethics standards: participation was voluntary with informed consent, anonymity and confidentiality were ensured, and data were handled in compliance with the Data Privacy Act of 2012 (RA 10173) and used only for academic purposes.

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