Effectiveness of Robotics Curriculum Implementation in Lyceum of the Philippines University Batangas – High School Department

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Abstract – *Robotics is an enhancement subject added to the Junior High school curriculum of Lyceum of the Philippines University Batangas for the academic year 2019-2020. Robotics aims to introduce artificial intelligence and basic concepts and principles of Robotics. This research aimed to assess the implementation of the Robotics curriculum by exploring on the teachers' teaching delivery and the program itself. A Descriptive method was utilized for the 217 respondents from the total population of 478 JHS students enrolled in the Robotics Program. Since the respondents answered online, a quota sampling technique was used. Results revealed that the teacher was evaluated as excellent by the respondents while the course itself was rated very good. It was revealed that the teacher was able to model the skills being taught however, there is a need to improve on using various strategies. Furthermore, It was confirmed that the teacher was able to use examples and illustrations, however, ensuring that there was adequate to prepare for each task. It is recommended that Robotics be continued as an added offering next academic year but ensure constant monitoring of its implementation.*

Keywords – *curriculum enhancement, robotics, technology integration*

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INTRODUCTION

Rapid technological growth has resulted in a global digital revolution, which is felt profoundly across all fields, including education. Our interaction with technology has also evolved: people are constantly surrounded by these technologies and tend to communicate with them passively. Teaching the "digital natives" (those born after 1995) is really a challenge to educators because technical advancements have a great influence on both the teaching-learning environment [1] and how the brain responds to these improvements [2]. Real-world problem-solving, meeting social needs, and strengthening quality of living are just samples of skills that are associated with technology-based education and its expectations.

In the study of Sullivan and Bers [3], children were able to learn simple robotics and programming skills starting in pre-kindergarten, while older children were able to master increasingly complicated principles using the same robotics package in the same amount of time. Age-appropriate design for the approach, as well as the timeline and phasing of the curriculum, were also addressed. The study also describes how robotics access and computer programming can be used in early childhood classrooms and what young children (pre-kindergarten through second grade) can learn with these tools.

It is already common to see young children explore foundational engineering principles by constructing and modeling from crafts, recycled materials, and LEGO parts in a traditional early childhood classroom. Sensors are encountered by children if they use a sink with automated water dispensers or enter a space where the lights turn on without the use of a button. These are the elements that are special in our society today because of successful technological innovation [4].

One of the most important national education policies of Japan is to emphasize the importance of learning programming for young children. In 2008, the government published a course guideline making it mandatory for junior high schools and make it compulsory for elementary students in 2020. Robotics has gained popularity as a school topic for educating young children about programming. Since it has a drive system, a sensor system, and a control system, it performs well as an interactive teaching content [5].

A substantial number of resources, improvement efforts, and regulatory reforms have been made to provide K-12 schools with infrastructure that allows all

students to succeed [6]. With increased access to technology, more educators have embraced and based their attention on how technology can be successfully integrated and used. Given the growing interest in technology and its use over the last two decades, considering teachers' perspectives and expectations of technology usage in K-12 settings has become critical [7].

The Department of Education Undersecretary (DepEd) Anne Sevilla quoted in 2018 that "the concept of robotics is new to the department and that they are looking into strengthening the current program on it and incorporating it in the DepEd curriculum" Also, for Anthony Gabitan, president of the Philippine Robotics Team, the study of robotics is vital in solving the current and future problems in the country and some benefits "studying of robotics and related conventions, competitions create awareness of technology... that we have to use equipment and tools to reach our objectives. Almost everything now is automated, there are machines we use and robotics is not exclusive to the idea of humanoids only, all innovations are all part of it" [8]. Information and Communication Technology (ICT) integration is one of the focuses of the Lyceum of the Philippines University – Batangas (LPU-B) High School Department in developing young learners' abilities to be successful in their chosen fields of specialization. One of the innovations implemented by LPU-B HS in the academic year 2019-2020 is the addition of the subject of Robotics as an enhancement to the curriculum.

Robotics aims to introduce artificial intelligence and basic concepts and principles of Robotics. Robotics and computer programming projects are gaining popularity among early childhood researchers and educators as part of a campaign to educate design and technology to young children [9]. Students get more involved in the learning process as they use robots. As the concept of Robotics is beyond the normal curriculum, the approaches to implementing Robotics in high school are very crucial. Educators have started to refine robotics to incorporate it into a variety of subjects. On the other side, high school students are at an age that is the ideal stage to enhance their willingness to gain knowledge in a particular field (e.g., science, engineering, technology, programming). This will help them overcome the technical difficulties because of the insufficient level of knowledge and skills needed for tertiary levels.

Robotics subject in LPU-B HS challenges students to integrate learned concepts from science, math, engineering, and arts in determining how their robots will sense, process, and act. Students are engaged in activities where they will solve problems about the four basic characteristics of robots: sensing, intelligence, movement, and energy. Some of these problems include detecting light, lines, distance, angle, and temperature. With the knowledge gained from this course, students can apply their knowledge of programming concepts in both the assembly and navigation activities.

OBJECTIVES OF THE STUDY

This study assessed the Effectiveness of the Robotics Curriculum Implementation Lyceum of the Philippine University Batangas Junior High School for the Academic Year 2019-2020. Specifically, it evaluated the Implementation of Robotics in terms of the teacher factor in conducting the classes and the learners assessed, Implementation of Robotics in terms of the Course program; identified strengths and weaknesses in how the teacher delivers the subject and determines further improvements. Finally, the researchers proposed an enhancement plan for the implementation of the Robotics curriculum in junior high school.

MATERIALS AND METHODS

This study used a descriptive method to assess the Effectiveness of Robotics Curriculum Implementation in the Lyceum of the Philippines University Batangas – High School Department in the school year 2019-2020. It aims to evaluate the performance based on the teacher factors and the course itself.

Participants of the Study

A total of 217 out of 478 JHS students enrolled in Robotics subject for the school year 2019-2020 are the participants of the study. This population is those students who responded to the survey online. The total population for this study was obtained using the Raosoff sampling technique.

Instrument of the Study

The instrument that was used is a self-made survey questionnaire which consists of two parts. The first part contains seven questions that assessed the implementation of Robotics in terms of teacher factors while the second part has 15 questions that assessed the implementation as to the course design itself. Instruments were content validated by the experts in engineering education, educational management (HS Principal & Area Chairs) and statistics. The 5-point Likert scale was used to test the reliability of the instrument with 5 as a very high level of need and 1 as very low. Also, the researcher invited one section from

the Grade 9 level which consists of 35 junior high school students who were not part of the study to serve as respondents for pilot testing. Table 1 shows the results of the reliability test for the two factors for course evaluation. The instruments obtained greater than 0.9 alpha coefficient which implies the instruments have very high internal consistency based on the rule of thumb.

Table 1. Reliability Results Implementation of Robotics Curriculum

Variables	No. of Items	α value	Interpretation
Teacher Factors	7	0.926	Excellent
Course Factors	15	0.974	Excellent

Legend: > 0.9 =Excellent; >0.8=Good; >0.7=Acceptable; >0.6=Questionable; >0.5=Poor; <0.5=Unacceptable

Data Collection and Procedure

At the end of the school year 2019-2020, the researchers disseminated the survey questionnaire to all JHS students enrolled in Robotics class. Using Google Forms, the link to the survey was endorsed to all JHS advisers to be forwarded to their respective students, and the responses were retrieved after two weeks of data distribution.

Data Analysis

The researchers asked the assistance of the university statistician for the treatment of the raw data that was tallied and encoded by the researcher. Weighted mean and ranking were used to describe the assessment of the effectiveness of Robotics curriculum implementation. The following scales were used to interpret the result. 4.50-5.00 = Excellent, 3.50- 4.0 = Very Good, 2.50-3.0 = Good, 1.50-2.0 – Fair, 1.49- 1.0 – Poor.

Ethical Consideration

The researcher ensured full confidentiality of all the data gathered and assured that all participants were given their full consent to participate in the conduct of the data gathered through a consent form attached to the instrument. Also, no personal information was gathered thus, all data gathered were for academic purposes only.

RESULTS AND DISCUSSION

Table 2 presents the Implementation of Robotics by Exploring in terms of Teacher Factors. It was revealed that there is an excellent evaluation based on the teacher factor having the composite mean of 4.58.

In the school year 2019-2020, all grades 8-10 of LPU-B HS have Robotics as an added enhancement subject. LPU-B HS, in partnership with TechFactors Inc., used the mBot Ranger 3-in-1 Coding robot from the company "Makeblock" as the main device that the teacher and student will use on all their lessons and activities.

Table 2. Implementation of Robotics by Exploring in terms of teachers factor on conducting the classes

Indicators	WM	VI	Rank
1. Teacher demonstrates knowledge of the subject matter that extends beyond the textbook.	4.62	Excellent	2
2. Teacher models the skill being taught.	4.64	Excellent	1
3. Teacher provides feedback to the students on their performance.	4.57	Excellent	4.5
4. Teacher provides opportunities for all students to participate in activities and discussions.	4.61	Excellent	3
5. Teacher provides opportunities for students to develop and explore his/her own ideas and experiences.	4.56	Excellent	6
6. Teacher uses a variety of strategies in order to teach all students.	4.51	Excellent	7
7. Teacher makes the classroom environment conducive to learning.	4.57	Excellent	4.5
Composite Mean	**4.58**	**Excellent**	

Among the indicators cited, first in the rank is "Teacher models the skills being taught" (4.64) evaluated as excellent, followed by "Teacher demonstrates knowledge of the subject matter that extends beyond the textbook" (4.62) and "Teacher provides opportunities for all students to participate in activities and discussions" (4.61) both also evaluated as excellent. When delivering instructions on a given assignment, the teacher must show how to do it correctly. Even if the directions are straightforward, modeling the procedure they would follow to complete the task is more suitable. They will be guided on how to complete the tasks in a specific manner. According to Strawhacker et al. [10], there is a statistical significance between a specific teaching strategy and high programming

achievement. Teachers' facilitation and modeling, which stressed mastery, self-directed learning, and free discovery within the software implementation context, is directly reflective of high achievement in programming learning results.

Meanwhile, even though evaluated as excellent, still in the least ranked are for the items "Teacher provides opportunities for students to develop and explore his/her ideas and experiences" (4.56) and "Teacher uses a variety of strategies to teach all students" (4.51). There are several pedagogical approaches that a teacher can use to help the learners understand the topic. It is the responsibility of the teacher to identify the most suitable approach to deliver the lesson based on the level of knowledge of the learners. However, it is not necessary that on one lesson, only one strategy will be used. Since most of the classes are composed of diverse learners, the teacher should be flexible and may use a variety of ways to deliver the lesson with the same goal to meet the learning competencies that students should meet. According to Noble [11], teachers who practice differentiated instruction agree that every child is different. Learning styles and preferences vary from person to person. They also agree that curriculum develops the learner's ability. Therefore, to address student's challenges in understanding the lesson, teachers must be able to change, extend, and/or enrich the curriculum with effective learning opportunities that recognize students' abilities rather than their learning deficiencies. On the other hand, teachers can significantly improve the educational robotics application after a certain training course is attended [12]. In addition, it is also very valuable that the behaviors of students are modeled after being examined regarding gender differences and activities with different difficulty levels [13].

Table 3 presents the Implementation of Robotics in terms of Course. It was revealed that there is a very good evaluation of the course evaluation with a composite mean of 4.39.

Among the indicators cited, first in the rank is "The course used helpful examples and illustrations to clarify the material as needed (4.56) evaluated as excellent, followed by "The course encouraged critical, original, or creative thinking" (4.53) "The course promoted thorough understanding of Robotics" (4.52) all evaluated as excellent. LPU-B HS robotics is designed to help children imagine the process of coding and managing the mBot Ranger. Examples and diagrams help to express the concept straightforwardly, especially when the teacher needs to deliver the instructions on actual steps to build the robot.

Table 3. Implementation of Robotics by Exploring in terms of Course

Indicators	WM	VI	Rank
1. The course promoted thorough understanding on Robotics.	4.52	Excellent	3
2. The course encouraged critical, original, or creative thinking.	4.53	Excellent	2
3. The course used helpful examples and illustrations to clarify the material as needed.	4.56	Excellent	1
4. The course stimulated my interest to learn more.	4.39	Very Good	6
5. The course helped me appreciate the significance of the subject matter.	4.34	Very Good	11
6. The assignments given were engaging to do and it enhanced my learning experience.	4.35	Very Good	8
7. The course corresponded to my expectations.	4.34	Very Good	11
8. The course has improved my problem-solving skills.	4.35	Very Good	8
9. The course helped me to conceptualize and present my ideas in my artistic medium.	4.34	Very Good	11
10. The course aided me to consider connections between course material and other areas of my personal, academic, or professional life.	4.35	Very Good	8
11.The schedule ensured that I can access all of the educational opportunities in the course.	4.32	Very Good	13
12. The schedule provided me opportunities to seek, receive, help, support, and enriched in the course during the given time.	4.31	Very Good	14
13. The course offered an adequate time to prepare for each given task.	4.30	Very Good	15
14. The time given has provided some gaps between activities to allow collaboration and brainstorming in every group activity.	4.40	Very Good	5
15. The timelines given were enough to me for reaching measurable targeted outcomes.	4.42	Very Good	4
Composite Mean	**4.39**	**Very Good**	

Legend: 5.0 – Excellent, 4.0 – Very Good, 3.0 – Good, 2.0 – Fair, 1.0 – Poor

These types of course materials used in the class not only make the teachers' jobs easier but also encourage students to engage in class. The robot can operate based on the input provided by the user or device. By demonstrating how the supporting parts function and by attempting to program codes to drive the robot, it is shown that robotics influences many educational issues. It also has a major impact on students' talents and skills [14].

Meanwhile, even though evaluated as very good, still in the least rank are for "The course offered an adequate time to prepare for each given task" (4.30) followed by "The schedule provided me opportunities to seek, receive, help, support, and enriched in the course during the given time" (4.31) and "The schedule ensured that I can access all of the educational opportunities in the course" (4.32). Robotics was plotted on the schedule of Grades 8-10 once a week for one hour. The one-hour allotted time includes the discussion as well as the activities and assessment for the day. Often, when the activity is assembling the robot, an hour is not enough to prepare the materials and finish an assigned task. This has become a challenge with hands-on activities where the target learning competencies are not always fulfilled because the time left to complete a task following discussion is insufficient. Correll, Wailes, and Slaby [15] addressed in their study that the use of "Cubelets," a compact robotic kit that needs practically no assembly time, allows significant interaction and improvement in STEM perception in as little as a 1-hour session. With the elimination of the complex setup of a robotic kit, a 1-hour session is sufficient for discovering and exploring activities that can be done using "Cubelets".

CONCLUSION AND RECOMMENDATION

The results revealed that the faculty from the High school department who teach Robotics specifically for Junior High has an excellent performance for conducting classes while the course program is rated very good. Based on the findings, the researchers concluded that the teacher can show that they possess the skill being taught and the course or program is using helpful examples and illustrations to clarify the material needed. However, there is an excellent evaluation for teacher's use of variety of strategies in order to teach all students; the course is rated very good because it of adequate time allotted to prepare for each given task, though both of these indicators were ranked the lowest. An enhancement plan for the implementation of Robotics was proposed.

LPU-B High School Department may continue Robotics as an enhancement subject since there is an excellent evaluation on the implementation in terms of teacher factors specifically on conducting classes and a very good evaluation in terms of the course factor. The management may increase the exposure of Junior High School Teachers handling Robotics in various exhibits, expositions, webinars, conventions, seminar/trainings to equip the students with the latest trends on teaching robotics to improve competencies among students. The teachers may also revisit the course calendar/plan to ensure that there is enough time given to accomplish tasks. The management may conduct continuous monitoring of the implementation of robotics curriculum for Junior High School students. For future researchers, they may explore other factors affecting Robotics implementation specifically evaluation on the utilization of engineering simulation software, program and model.

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