

# Empowering Holistic Learning Experience through Project Outcome-based Learning (Po-BL): Reflecting on a Case Study of Malaysian University Undergraduate Students

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The application of Project Outcome-based Learning (Po-BL) has been applied in teaching and learning environments for many years. Po-BL plays an important role in ensuring students learning effectiveness and frequency. Po-BL offers tangible invention as a result that is proof of student participation and which confirms student competency in the relevant subject-matter. However, it is often misinformed that not only can Po-BL transform student comprehension, in the context of the subject matter at hand, but also indirectly promotes student practical understanding which becomes the ultimate goal of the teaching and learning. This research argues that the existing accepted method of Po-BL, was not solely designed for the purpose of developing a product, but also encourages overall student learning experiences. In contemplating the issue, this research is a case study of 40 undergraduate students enrolled in STE3603 (Manipulative Skills III). This course takes 14 weeks (one semester) to complete. The students have undergone myriad Po-BL activities and participated in organizing an Innovation Showcase at the Faculty of Educational Studies, Universiti Putra Malaysia. As part of the showcase, students were able to exhibit their invention (Robot) by contesting in a RoboWars competition. The students who experienced multiple phases in the Po-BL activities were invited to be part of the research study by answering online qualitative open-ended questions via Jot Form. The questions were formulated in a broader sense to allow participants to reflect on their entire experiences from Po-BL activities. All responses were downloaded in an Excel Spreadsheet and analyzed using two different phases, both Word Cloud and thematic analysis with the color-coding

technique. The themes that emerged from the study describe the entire learning outcomes from the Po-BL experiences, which guide future research to glean more understanding on what Po-BL potentially offers.

**Key words:** *Project Outcome-based Learning, Problem-based learning, Experiential learning.*

## Introduction

There are numerous teaching and learning (T&L) techniques and methodologies available in the related research, and students either benefit from or are discouraged by the techniques used by educators in the classroom. This phenomenon has always intrigued those in the field of education academia and research. Scholarly research generally indicates that Project Outcome-based Learning (Po-BL), also named Project-based Learning (PBL) is one of the most favorable teaching and learning methods. It can be proven that Po-BL has ousted conventional teaching methods, however, there is still a question as to what extent Po-BL can be optimized during the entire learning experience. It is interesting to note that students are connected to Po-BL application due to its structural learning phase and the swiftness in fulfilling the project objective, which consequently mostly stimulates them in the classroom.

To begin with, Po-BL involves students in developing projects through cooperative investigation in the context of feasible problems posed through this classroom pedagogical approach (Bell, 2010). The emphasis of Po-BL is on student engagement in problem inquiry and involves finding solutions to problems that arise simultaneously from the process, so that learners ask and refine questions, discuss ideas, generate hypotheses, design a plan, experiment, collect and analyze data, draw conclusions, communicate ideas and question in order to create prototypes or models (Moursund, 2007; Farooq & Younais 2018). Thus, Po-BL reduces the gap between theory and practice by giving students real-world projects in various contexts (Zhan & Porter, 2010). These entire experiences enrich student academic knowledge and practical skills in empowering their understanding of specific subject matter. While learning-by-doing is a powerful tool to gauge student learning effectiveness, Po-BL inspires educators to ensure the learning objective is attainable.

Put simply the Po-BL teaching method embeds innate structural and systematic process for both instructors and learners. Po-BL stimulates a self-discovery process that becomes the vital characteristic of this methodology. The discovery of previously inconspicuous relationships and similarities between notions leads to self-confidence in one's abilities and enhanced excitement for discovery (Bruner, 1960), where self-discovery processes occur while participating in Po-BL. Hence, the application of learning is an important element for Po-BL



as students draw upon their knowledge and apply it to design their own project. This combination of ideas leads to higher levels of thinking skills (Shekar, & Seidel, 2009).

Moreover, Po-BL is basically distinct from traditional teaching approaches that rely on lectures due to the unstructured (open-ended) problem that is posed before the teaching of the theory. This encourages students to learn and foster the interrelations between skills and concepts that are required to seek meaningful solutions (Ribeiro & Mizukami, 2005). Bruner (1960) argues that certain attitudes or approaches to science can be taught in earlier grades and are significantly relevant for later learning due to the link between principles and ideas. Students who are introduced to a topic earlier can then search for new ways to solve the problem using their existing framework (Powell, 2004).

Scholars incorporate different terminologies to inculcate Po-BL as a form of active learning into classrooms such as project-organized learning, problem-based learning and project-oriented problem-based learning. Whilst Powell (2004) arguably differentiates between Po-BL and problem-based learning place on the depth of the learning activities, Po-BL or project-organized learning, on the other hand, involves an entire project on a longer and larger scale that could last a whole semester. In contrast, problem-based learning revolves around one problem that lasts for a short period (i.e. a week or a few weeks). In these projects, structure and guidance are an important provision to help students plan and enables them to concentrate on a particular subject area. Additionally, Thomas (2016) identified the following five criteria that distinguish Po-BL from other methods: “(i) projects are central, not peripheral, to the curriculum (ii) project creation forces students to encounter and solve issue that is linked to important concepts and principals of the subject area, (iii) projects require constructive investigation, (iv) projects are student-driven, and (v) projects are real-world (p. 3)”.

This article presents some of the pivotal learning outcomes from the respondent student Po-BL experience. A qualitative case study was employed to carry out this study for the purpose of determining students learning outcomes from the process of Po-BL as experienced by the students. The research questions underpinning the study are:

- (i) What are the most important things learned by the students from Po-BL?
- (ii) How does Po-BL improve students learning?

## Literature Review

Po-BL T&L techniques presented by educators in the classroom have become increasingly one of the most chosen pedagogical approaches. In fact, Po-BL has developed its popularity in disseminating academic knowledge and practical skills in most subject matters. In the idyllic Po-BL setting, where knowledge and understanding is exchanged, the potential abilities and talents of learners are identified and therefore it is a favorable pedagogical choice to most

educators. It is fair to claim that Po-BL is a successful method to measure student academic performance and to retain learner motivation when engaging in the classroom ecosystem as well as promoting the use of multiple intelligences when compared to any other traditional instructional methods (Baş, & Beyhab, 2017). In addition, in the face of encumbrance problems and issues pertaining to stagnant teaching and learning processes in many classroom situations, Po-BL tailors a number of attributes that could empower student overall learning experiences. As such, Han, Capraro, and Capraro (2015) found that Po-BL succeeded in improving the achievement of low performing students in Science, Technology, Engineering and Mathematics (STEM) and consecutively helped in decreasing the achievement gap between low and high-performance students. Furthermore, the framework of Po-BL comprised problem and inquiry process, development of product or artifact and exhibition and presentation of research outcomes which benefits the whole process of understanding academic knowledge across a range of subject matter.

Po-BL has been applied in T&L platforms for many years. This approach has been studied in various research contexts and subject matter (see Bilgin, Karakuyu, & Ay, 2015; Han, Yalvac, Capraro, & Capraro, 2015; Poonpon, 2017). On the premise that Po-BL has being employed in numerous subjects, it guides teachers and students to abstain from a monotonous and fruitless T&L environment. Po-BL promotes students to develop better performance and skills in science and technology-related subjects and additionally, prosper intrinsic values including self-efficiency as compared to traditional methods (Bilgin, Karakuyu, & Ay, 2015). Students feel confidence in the Po-BL environment that emboldens them to engage in trial and error, knowing there is no problem in making mistakes. There is nothing ambitious and ambiguous about something that a student may produce through Po-BL, rather their involvement portrays them as pragmatic learners that learn-by-doing. The encouragement should be placed on what the students have achieved to date rather than measuring the ultimate goals of learning. Therefore, students are not exposed to pressure and enjoy learning freedom and also experience the element of knowing by coincidence.

If students persist and persevere with the Po-BL activities through to project completion, they might discover the beauty of Po-BL which comes from the entire satisfaction and motivation that will shape their personality and attitudes towards certain subject matter. Poonpon (2017) suggested that Po-BL contributed to a positive teaching and learning atmosphere by referring to English for Information Science subject. The researcher imposed Po-BL to encourage students to link their language skills and content knowledge. The study indicated that the implementation of project-based activity prospered student language skills and their knowledge about Information Science and Technology Skills from their participation (Poonpon, 2017). The result of this study suggested that within cross-interdisciplinary subjects, Po-BL is a legitimate method for T&L that holistically empowered any learning content to reaffirm the process of transferring knowledge which happened within the classroom context.

Further impressive and positive attributes from Po-BL activities include cross-disciplinary knowledge and procedural experience with effective tools in Science, Technology, Engineering and Mathematics (STEM) subjects. Po-BL is considered an induction tool in ensuring effective and impactful T&L happens. Research by Han, Yalvac, Capraro, and Capraro (2015) on a group of in-service teachers indicated that the Professional Development (PD) training was found useful in communicating several important concepts about STEM Po-BL, however, they found that teachers sometimes presented different enactments to what the PD providers intended. Some teachers did not change their instructional strategies and other teachers acquired misconceptions. It was interesting to note that teachers in that particular study regarded STEM Po-BL as a fairly new instructional pedagogy and teachers had a variety of challenges in implementation, even though PD training, seminars, and conferences on STEM Po-BL had been provided for these teachers (Han, Yalvac, Capraro, & Capraro, 2015). Although the findings are contradictory to some of the positive outcomes from Po-BL, we can conclude that some teachers have not been attentive to the potential of this teaching method.

Regularly, different teaching methods that achieve success in T&L are highlighted. Frequently, however, teachers are concerned with to what extent students comprehend the knowledge and the ‘meaning-making’ process from the classroom. Po-BL offers a broader spectrum in delivering meaningful knowledge creations through structural teaching and learning processes. The hybrid form of teaching based upon educational models of PBL and Po-BL assists teachers to transform teaching and learning context to student-centered learning and give sustainable mandates to students for discovery and experiential learning (Cörvers, Wiek, de Kraker, Lang, & Martens, 2016). Ultimately, the hybrid of different forms of instructional procedure prospers the positive atmosphere of T&L environments to educate the next generation who can come from diverse backgrounds and fields of study. Educational experts, on the other side, benefit from academic and professional exercises for their career that entirely help them cater to ever-changing pedagogical approaches, especially in 21<sup>st</sup>-century education evolvement.

### ***Principles of Project Outcome-Based Learning (Po-BL)***

Po-BL comes with necessary tentative and structural processes in order to ensure whatever activity involved in Po-BL from the initial process comes to an end (product/artifact/findings/tangible or intangible outcome). Therefore, below some essential principles of Po-BL, depicted from Bosson and Dean (2016), must be adhered to:

#### ***Project is realistic***

The project used to reach its resolution must be related to authentication and real-life scenarios. The problem or question can be directly related to the life of the learners, their wider

community or their future potential. The driving question is one that is related to the academic and future professional lives of learners. The way of acquiring information and communicating a project/research may lead to the presentation of a poster based on real-life status quo which the students may experience in even their own forthcoming undergraduate education. The establishment of links and the emphasis on the present or future usefulness of the knowledge, competencies, skills and attitudes developed through the project will probably enhance the commitment and motivation of the learners.

### ***Learner-driven project***

It is significant that teachers have belief in the ability of their learner to complete the project and give them positive reinforcement which encourages continued effort. The teacher must give up a measure of control that empowers learners with a certain level of choice and control over the situation. Learner choice does not translate as complete freedom for the learner as the project operates within the standards and expectations of work. In these parameters, learners are supposed to discover their own solutions to problems and ways to work. The teacher can ask the question, but the students' specific interests and approach to the question will determine the answer. Thus, different groups would respond to the question with diverse solutions.

### ***High quality work is required for the project***

Po-BL has an expectation that promotes the message of growth-oriented learning and learners in this methodology increase their struggle to create a product that brings high-quality results. Instructors must strengthen these core values and recognize the significant results and trust in the ability of learners to accomplish them.

### ***The project includes collaboration and teamwork***

Po-BL is a team-centered activity in which the majority of the learning process occurs in teams or groups. Thereby, personal skills are developed so that students can handle the process of group cooperation in all its stages. Effective teamwork needs a wide range of skills and attitudes and the relevance of teamwork is that individual members incorporate different teams and projects in order to succeed. The nature of the team-based project should not discontinue the learners' evaluation and undoubtedly some will take more to a project than others.

### ***The project offers a forum for the outcome of the project***

Po-BL focuses on building student ability to develop a realistic, creative and tangible solution of the problem through teamwork. After completing the project, the team may present their work to the class or to a community forum. The community display and appreciation of the

project also gives the message that the teachers and the institute value the principles of the student-centeredness embedded in the project.

## Methods

The research design underpinning this study was a qualitative case study. This research depicted Po-BL as the main subject where the learning outcome of the students was examined. The themes that emerged from the narrative given by the subjects were the predictors of Po-BL effectiveness in the T&L processes. The benefits that the project or program have undergone would elucidate the necessity of the future projection of overall experiences (Jacoby, 1996). Students who are involved in Po-BL were the primary resources for the data collection and the research findings were triangulated by comparing and contrasting data from project rubrics, observations and reflection notes.

A sample group of 40 students was involved in an online, structured questionnaire distributed using an online platform (JotForm). The questions were created in a broad sense to allow research subjects to respond to the questions via narrative form and storytelling and ‘openness’ among the respondents was encouraged. The narrative and feedback from the respondents were then analyzed using constant comparative analysis and color-coded technique using Microsoft Excel spreadsheet. Further, the use of Word Cloud retrieved from open source website (<https://www.wordclouds.com>) was applied to indicate the pattern of text before suggesting suitable themes for such narratives. The themes that emerged from the study were then discussed to describe subject responses in order to ensure authenticity and conformability of the narratives was guaranteed.

The subjects of the research were chosen from students enrolled in STE3603 (Manipulative Skills III) course for the whole semester. One of the course components required students to participate in a Po-BL involving 30% of their final mark of 100%. The Po-BL project took 14 weeks to complete and students spent 3 hours per week at the lab. The project required students to develop a robot containing structures, instrumentation, logic control and a computerized system. The tasks were delegated in a form of group work. Each group consisted of five students and a total of eight groups were involved respectively. At the end of week 14, there were a total of eight robots produced and these products were participants in the Innovation Showcase organized by the Faculty of Educational Studies, Universiti Putra Malaysia. The research observation took place for the whole 14 weeks. During the observation, field notes were taken by the researchers to gain understanding and reflect on how Po-BL could enrich students’ meaningful learning experiences through the job scope. Also, the use of rubrics for the Po-BL was utilized to help appointed judges assess each group’s robot. Figure 1 below depicts the rubrics for the Po-BL project:

**Figure 1.** Rubrics for Robot Development Project

**RUBRIC: Final Semester Project**

Group Number/Name: \_\_\_\_\_

CATEGORY	10	7.5	5	2.5	SCORE
<b>Scientific and Problem-Solving Skills (EPS 7)</b>	All students in group could easily and correctly state several facts about the topic used for the robot without looking at the robot.	All students in the group could easily and correctly state 1-2 facts about the topic used for the robot without looking at the robot.	Most students in the group could easily and correctly state 1-2 facts about the topic used for the robot without looking at the robot.	Several students in the group could NOT correctly state facts about the topic used for the robot without looking at the robot.	
<b>Scientific and Problem-Solving Skills (EPS 7)</b>	All information on RBT made for the robot are correct.	All but one of the information on RBT made for the robot are correct.	All but two of the information RBT made for the robot are correct.	Several information on RBT made for the robot are not accurate.	
<b>Practical and Psychomotor Skills (EPS 2)</b>	Contrasting ideas and at least 3 original creative components were used to give the robot appeal.	Contrasting ideas and at least 1 original creative component were used to give the robot appeal.	Contrasting ideas and "borrowed" creative component were used to give the robot appeal.	Little or no idea or fewer than 3 creative components were included.	
<b>Scientific and Problem-Solving Skills (EPS 7)</b>	Report were written clearly enough that all could easily understand.	Report were written, but one part of the report needed slightly more explanation.	Report were written, but people had some difficulty figuring out the product.	The report was not written.	
<b>Interpersonal, communication, and Teamwork Skills (EPS 5)</b>	The group worked well together with all members contributing significant amounts of quality work that includes presentation.	The group generally worked well together with all members contributing some quality work that includes presentation.	The group worked fairly well together with all members contributing some work that includes presentation.	The group often did not work well together and the game appeared to be the work of only 1-2 students in the group that includes presentation.	
<b>Practical and Psychomotor Skills (EPS 2)</b>	Excellent amount of work has been paced to the development of the robot	Good amount of work has been paced to the development of the robot	Fair amount of work has been paced to the development of the robot	Little amount of work has been paced to the development of the robot	
<b>TOTAL SCORE</b>					

Evaluation was performed by:

**Research Findings**

Two phases of data coding analysis were employed. The first phase involving the use of color-coding analysis of possible words that emerge from respondent narratives. All the words were then transferred to Word Cloud software to interpret the pattern and to exhibit the most influential feedback produced by the subjects. From this process, themes were developed that described possible overall feedback. Three questions were specifically developed to assist in answering the formulated research questions. The questions were:

- (a) what is the most important thing you learned in this project?
- (b) what do you wish you had spent more time on or done differently? and,
- (c) what part of the project did you do your best work on?

Minor grammatical error corrections were made as necessary on the narratives as to ensure the originality and authenticity of the data was secured.

### *Soft Skills for Employment*

The discussions of the results begin with the subjects' narrative from questions posted online. 40 responses were received with a cumulative response rate of 100% for all three questions. Figure 2 below is a wordle derived using Word Cloud software as a method to illustrate the pattern of response from the first structured open-ended question. These findings highlighted teamwork, knowledge, cooperation, creativity and management, which are the largest text sized words on the on the Word Cloud interface (wordle) below.

**Figure 2.** Word Cloud software depicting textual emergence from structured question 1



There were few signs that impressive and imperative produced by the narrative feedback based on our first question. Students inclusively worked independently in conventional methods of teaching and learning as compared to Po-BL which allows a student to get involved in group work. Therefore, the emergence of teamwork presumably indicated the most highlighted feedback from the transcripts. For example, informant (1) indicated that,

*“(t)he most important thing that I learned was, working as a group to design, assemble, test and participate in the tournament”* anticipated teamwork was the factor that the student learned the most while learning to develop the designated project. On another note, informant (8) shared his/her notion on the importance of having teamwork in spirit, *“to accomplish this project, we need support from each member, although all of us do not know anything about robot, but we still support each other until the robot is done”* describing that a difficult task can be accomplished with the spirit of teamwork. Student ability to demonstrate collaborative work in Po-BL increased their understanding of the significance of teamwork in dealing with Po-BL activities. Informant (9) espoused that, *“(t)he most important thing is teamwork. It is very important on making something successfully done”* and informant (25) supported this by

stating, *“the important thing that I learned in this project was to build teamwork and generate the new idea for this project” propagating the outcome from working in a team”*.

Many thoughts were given to ways and means of developing student soft skills during an educational journey. For success in the employment market, the development of soft skills is mandatory. The element of cooperative skills was practiced in Po-BL project and Informant (30) shared his/her experience from the Po-BL activities, *“(t)he most important thing that I learned in this project is cooperation between group members. Good cooperation will give a good result”*. On another note, Informant (16) agreed that cooperative skill was a vital tool in solving any related issues and problems while dealing with the project. He/she claimed that *“(t)he important thing that I learned in this project is all of the members in a group must be cooperate with each other, then we also need to help to solve the problem”*.

Further, the important element of applying knowledge to practicality as portrayed in most Po-BL environments, is that this activity promotes students ability to develop their creative and critical thinking through problems solving and issues related to the project. Informant (23) agreed that Po-BL helped a student to overcome any problem by practicing their creative and critical exercise, *“I learned about to think creatively and how to overcome problems during the process. Besides that, I can learn how to coding and programming software”* which added to the skills kit of students. Despite training students in creative and critical thinking, informant (9) suggested that Po-BL was able to help him/her to explore *“something new and become innovative”*. Informant (5), on the other hand, encountered a situation where *“the technic to do the robot and how to solve a problem with use technology item like kits, motor and else....the other things is sharing some tips”* assisted his/her overall experience in Po-BL.

Student involvement in organizing the Innovation Showcase helped them to develop managerial skills, which played a major role in creating a successful 21<sup>st</sup>-century employment setting. The managerial skills involved time management, leadership, and knowledge creation which are some of the most important traits that ensure survival in a challenging job market Po-BL became a platform for students to practice those aforementioned skills. Informant (7) for example, stated that *“(i)ts about time management, leadership, and knowledge”* the thing that the subject learned through Po-BL experienced. Informant (20), on another note, claimed, *“I also learned how to handle the program. More I learn how to make a robot and the most importance I learn how making the timeline the project and make sure it’s not overdue, accumulatively reflected his/her overall experience”*.

Meanwhile, a few exceptions to the general narrative produced meaningful feedback that helps understand the Po-BL outcome. One informant (9) disclosed that Po-BL was important to *“carry out the entire project by applying higher order thinking skills”* supporting the previous findings on developing creative and critical thinking skills. The student was able to *“learned about new things in the innovation of a product according to the latest technology*

*development*". Similarly, the student was able to demonstrate their communication skills as Informant (19) reflected, *"I learn how to communicate with people well"*.

### **Profound Life-long Learning Process**

To begin with, the presence of Po-BL in T& environment undoubtedly enhances students overall learning experiences. In fact, Po-BL has proven to be one of the most engaging teaching techniques practiced by educators. To validate this statement, students were asked a reflective question that explored how Po-BL benefits students from their own perspective. The question was posed "what do you wish you had spent more time on or done differently?" through the online form. The feedback was then transferred to the Word Cloud software and the result is shown in Figure 3 below. The four big enlarged words that emerge from the software are learned, research, program management and exploration.

**Figure 3.** Word Cloud software depicting textual emergence from structured question 2



The majority of the subjects pointed out that they wish to learn more in the process of developing a robot. While many of them had not had preliminary knowledge about some basic robotics, they became interested and more appreciative of the subject matter including the software and hardware used in their project. Informant (8) for example stated *"(w)hat I wish I had spent more time on are about the coding system. I wish I can learn more about the coding system so that the robot will work smoothly"* depicting enthusiasm in learning new information. Many of the respondents were required to explore by themselves with most situations falling into a *"trial and error"* scenario. Despite the challenges that most students encountered, they produced functional robots that allowed them to discover more about how to make an even better robot. Informant (35) as such regarded one situation that became a pitfall for his/her group when one of the accessories on their robot malfunctioned *"(d)uring the blade*

*installation, I wish it can be more tighten and safe during RoboWars”* which portrays a corrective measure undertaken by the students. On the same note, informant (40) described his/her experience when dealing with issues pertaining to a controlling system of the robots *“(m)aybe on the robot itself. Many of us using the same system. So maybe, if I could learn how to make the robot a little bit different, then I can be proud of myself and of course my team as well”*. It was concluded that the technical glitches occurring during the Po-BL were part of the reasoning methodology that is a learning phases in Po-BL and precipitates for students their interests on robotic and instrumentation subjects.

The word *“research”* appeared four times in the transcription script, hence its meaning has given impactful learning experiences for students in understanding their reflective process. Research in this context referred to students’ exploration of new knowledge based on the existing understanding of the subject matter. With regard to perceiving the concept of research, students valued Po-BL as a platform to discover more about robotic knowledge through research exercise. Informant (27) asserted that *“(i) wish I have more time on built robot project and also more time to do a research about it”* enclosed his/her hopeful plan for the next project. This notion was supported by informant (32) in that he/she wished more time could be given for students to discover more research on the robot development process, *“(i) wish I have more time to do research on how the robot works to defend and attack from something”* as well as Informant (42) who described, *“(i) wish I had spent more time on my research to find more information in order to get an excellent outcome”*. Since time was the issue, Po-BL on the robotic subject should in future consider that 14 weeks of lessons seemed to be inadequate for students to employ exploration and research processes in this context.

Despite being involved in the process of developing the robots, students were involved in organizing the Innovation Showcase by taking a major role in conducting the RoboWars competition. It was agreed that program management had become one of the outcomes of the Po-BL activity. Informant (5) immersed himself/herself as a program organizer and gave meaningful feedback of the overall program as stated in the description, *“(i) wish that the activity like this have more activity and many people from outside will join. More people, the best gift like money or hamper are good. Perhaps after this have the best gift to all the participants not only one gift for one group”*. Informant (19), furthermore, shared his/her belief in the overall program as *“it will be much successful if we can collaborate with engineering student especially those from robotic clubs”* concerning the RoboWars event. Moreover, informant (39) advocated that the overall program was a success by stating, *“in my opinion the duration of the program is very appropriate and multiple slots or multiple matches that are ideally innovative”* as well as referring to the league match of RoboWars.

The Po-BL methods for handling a final semester project implied more than giving students the freedom to explore in a meaningful T&L environment. Students were encouraged to

explore the environment in order to scrutinize the theoretical and practical knowledge and be prepared to exhibit their product at the end of the Po-BL process. When students were given the chance to explore, they were able to immerse themselves in self-learning which undoubtedly assisted them in memorizing and remembering the knowledge. Informant (15) for instance wished to, “*explore each part of the robot carefully before built it*” portraying his/her personal experience after being defeated in the RoboWars competition. In similar findings, informant (30) stated his/her opinion that “*i wish I have more time to create our robot project and also more time to explore about the robot thing*”.

After 14 weeks of Po-BL activities, students demonstrated their robots by participating in a RoboWars competition. The competition was part of the assessment and evaluation process. The timeline given in the Po-BL was initially presumed sufficient for students to complete the robot, however there were flipped comments and narratives from the students such as Informant (16) reflected upon his/her overall experience while carried out Po-BL as “*i wish more time cause when doing the robot, the robot has a bit problem*” a coerced unintended result when it comes to the real event. Time was of much concern to some students as evidenced by Informant (17) who stated that “*i wish I will spend more time to do the innovation on the robotic for this project*”. Informant (26) also described that “*i wish we were given more time to create the best robot to fight*”. These reflections were derived from the transcripts and were useful to share as study findings as time was considered one of the crucial factors in Po-BL.

### **Momentary Constructive Satisfaction**

Deriving from the transcription analysis based on the question, “what part of the project did you do your best work on? Research subjects described narratives which contributed to the emergence of words as illustrated in Figure 4. A consensus was reached to find the suitable themes for this question by portraying the reflective process of Po-BL. The students were highly satisfied as evidenced through their premise in the narratives. Although, there was no specific word describing satisfaction, most of the narratives revealed satisfaction as an emerging theme in the meaning-making process. Principally, this theme represented how students are able to reflect the entire Po-BL experience by pointing out a specific event during the project and this included the entire event of the Innovation Showcase and particularly, the RoboWars competition. Specifically, students described their experiences in overcoming issues pertaining to robot development. In this theme, four words were a particular focus as portrayed in Figure 4 below.

Figure 4. Word Cloud software depicting textual emergence from structured question 3



Students enthusiastically participated in the RoboWars competition and most students were witnessed perspicaciously competing with each other. This experience was vital to maintain their motivation during the competition as well as a testing platform for their project outcome. This environment was closely examined by taking field notes and asking an open-ended question in the online form. It is important to highlight that the words “*design*” and “*system*” were always connected together in student transcripts. The words design appeared and gave meanings six times in the transcription. Informant (4) for instance shared his/her connotation by stating, “(i) would say, the part of the project that I really work on is designing the robot and applying the system to the robot according to the group plan. And also team up with my group to explore more on robotic”. Also, Informant (11) stated that “(m)aking the body of the robot” was one of the PO-BL activities that he/she worked at their best. It is arguable that for students who have limited knowledge in robot-making, difficult experiences in several aspects were encountered, especially dealing with designing and developing the frame and body. This was described by Informant (22) who highlighted specifically the challenging situation where “(w)e have created ‘Robot AVATAR’ wish is the great work in my life. The part that I put more effort is the power windows part and of course, the decoration part of our AVATAR looks”. One of the momentary situations where the effort from students to ensure their robot could move after losing games by repairing and modifying their robot intrigued the researchers. Informant (28) for instance keen on assuring the group that they would win the competition, “(t)he best part is when we have last minute problem with our robot body, then we manage to think the solution immediately and we got no.3 in overall competition” indicating their motivation and self-achievement.

Despite facing some difficulties and deterrent issues pertaining the robot especially during competition, students were able to make some “*modifications*” before or during the event. Informant (34) discovered that in order to make the robots more responsive and powerful, the basic system needed modification, “*(t)he best work on is learn something new how to change the speed of this robot, where we change that total of battery to make the robot more powerful*” where these two elements are crucial to ensure the robot works as expected. The students also discovered some modifications were necessary for the circuit board of the instrumentation component for the robot. Informant (35) for instance, suggested that “*the assembly of the blade must be carried out according to the instruction given in the map although we use an old circuit board*”. This momentary event sparked much student interest in the application of some modification to their robot in order to win the competition. Informant (9) *felt the heat* of the competition when he/she discovered, “*(w)hen creating something that stuck in my mind throughout the process of making robot looks different from other groups*” exercised critical thinking skills and projected solutions toward problems he/she encountered.

As students pursued their Po-BL in making the robot, another element that strengthens this theme was discovered, which was intrinsic and value-added. This finding was corroborated this finding with student overall experience as to depict motivation and self-belief in accomplishing and overcoming challenges as constructive values that emerged from Po-BL. This value described the event that took place during the competition. Informant (21) related, “*(o)ne of the best achievements in this activity was I able to fight with other robots. I was able to win one fight although the rests of the fight I lose or draw*”. In addition, Informant (36) also commented, “*(i) have worked at my very best for my robot although I was ranked in the last place*”. These two responses indicate that motivation and self-belief of students about winning the competition was not their primary intention, however, they more consistently paid efforts and struggled to accomplish the project within the competition circumstance. The element of motivation and self-belief were the positive values that needed to be nurtured among students at many levels of the educational environment.

## **Discussions**

When the study was carried out, students were convulsed with enthusiasm and excitement. In the initial plan, the Po-BL activity was not as dominant as the researchers expected. However, through collaboration with the Innovation Showcase organizer, Po-BL was embedded in one of the criteria of that particular event. After the realization that students were obsessed with competing in RoboWars, it was decided to appoint a few students from the Po-BL group to take part as committee members in the Innovation Showcase. Eventually, appropriate planning for the RoboWars competition was made and invitation to participate was made to all university students. The event was a success, where the entire student cohort enjoyed the overall

experiences of Po-BL and Innovation Showcase. It was surmised that Po-BL had produced impacts on students' entire learning experiences.

Initially, Po-BL proposes salient indications of developing soft-skills of students. Students possess different traits of soft-skills, which galvanize their ability to place themselves in the current challenging job market. Similar findings by Musa, Mufti, Latiff, and Amin (2012) are that Po-BL has befitted as a trend in T&L where it is an ideal method to foster students' soft-skills. Students are able to demonstrate teamwork, project management, communication skills, interpersonal skills and problem-solving skills while participating in Po-BL. This is somewhat relevant to the skills-to-work traits, which are highly recommended by employers as the aforementioned skills are commonly practiced in 21<sup>st</sup> century organizations.

It is imperative to note that the combination of theoretical and practical knowledge can flourish from organized Po-BL activity. Students were intense with the overall activity that derived from team spirit and motivation to accomplish the product. On top of that, students were able to acquire theoretical and practical skills in the form of formal and informal learning through Po-BL. These competency skills are relevant and important to embed throughout students' educational journey, especially when preparing them for employment. Woodward, Sendall, and Ceccucci (2010) agree that competencies in both technical and soft skills such as interpersonal communication, teamwork, time management, planning and organizational skills are highly regarded student skills and abilities. Some skills are embedded in both the elements of theoretical and practical. Thus, students venture in a milieu of ubiquitous opportunities and recognize the potential of Po-BL to empower their employment skills.

Educational institutions articulate different teaching techniques to suit the current student generation. While the pace of focusing on students become less and less, they are the generation that is bombarded with technologies and the rapid advancement of social networking sites, mobile applications and games. It is a challenge for educators to ensure that at the same time students are enjoying all the facilities; they are immersed in the teaching and learning environment. One way of mitigating the effective learning instruction is through Po-BL. Indeed students would be able to acquire new core skills (subject-matter) and obtain very good academic results Macías-Guarasa, Montero, San-Segundo, Araujo, and Nieto-Taladriz (2006), while in the meantime enjoying the learning process. Today, with the paramount influence on forming student's opinion of what is the best learning environment for them, it is commonly regarded that it must be the educator's initiative to make the teaching and learning become fun and enjoyable for them. Therefore, Po-BL becomes one of the best solutions to cater to student needs.

Po-BL impacts on students' enthusiasm to learn were further explored in this research and based on the findings, Po-BL projected the motivation for students to learn more subject matter

although they may not be exposed to that particular knowledge in the initial process. The notion is thus posited from this study that a student's eagerness to continue learning propagates life-long learning. Dunlap (2005) for example established that Po-BL was able to support life-long learning because it provided students with engagement activities that develop self-directed learning, metacognitive skills and authentic and experiential learning from a discipline-focused activity. This environment helps the student to ensure sustainability in the process of learning although they have completed their degree. Po-BL supports the process of life-long learning because there are so many things to discover depending upon the subjects that students prefer. The spirit of life-long learning intensifies and the intention of pursuing more knowledge is presented in more efficacious ways due to participation in Po-BL projects.

In addition, the fast and ever changing technology, globalization and challenges in today's employment market have coerced people to be more up to date with current innovation and creation. In fact, the overhanging has awakened educational institutors to further reconnect and synchronize with what industry needs are directly from the employer. Hence, it is a wide-awakening for educational institutions to vary teaching and learning technique not only to increase students' academic performance but also encourage life-long learning. A Po-BL activity can engage learners through full participation to life-long learning skills, problem-solving abilities, working independently or in a team and effective communication as self-directed learners attending to their own professional development needs (Heinrich, Bhattacharya, & Rayudu, 2007). Thus, it becomes a responsibility of the educational institution to prosper life-long learning through mitigating students in Po-BL activities as universities need to take responsibility in preparing students for lifelong learning.

This study was contradictory to what Orús, Barlés, Belanche, Casaló, Fraj, and Gurrea (2016) reported in their Po-BL research. They found that participation in activities related to project-based did not influence students' satisfaction levels with the course content and it is interesting to note that further influence on subjective learning was negative. It is presumed that students were more familiar with co-curricular activities rather than a class-based project, which could stimulate further possible studies. The above finding is consistent with Rubenking, & Dodd's (2017) study. They examined the alteration on students learning content by imposing some elements of Po-BL activities including group work that did not contribute to a positive impact on students learning job satisfaction. It was realized that the determinant factors to understanding learning job satisfaction was that Po-BL must be carried out vividly in combination with a structured plan to ensure students committed and grasped the beneficial outcomes from the whole set of activities.

It was discovered that students prefer activities that challenge their creativity and represent something new which triggers their excitement and desire to know more through those particular activities. When Po-BL becomes monotonous and stagnant, students might feel



disengaged due to the activity failure to challenge them or perhaps they are introvert in the sense of capability to work on a team. The nature of Po-BL, which is known to motivate student immersion with a problem-centered method, encourages them to understand the entire core of the teaching and learning environment and is a platform for them to not only acquire academic knowledge but also prepare them for industrial practice (Zhang, Hansen, & Andersen, 2016). There are now fortuitous opportunities to get into understanding the nature of workplace organization environment as derived from Po-BL that transmit overall experiences into elements students will need in their future career.

## **Conclusion**

The purpose of this study was to examine how Po-BL could benefit students in their learning and to promote Po-BL as a method to develop students' soft-skills for the 21<sup>st</sup> Century job market. The need for improving teaching and learning methods came became paramount because students were struggling to understand new learning content – which some of them encountered with zero preliminary knowledge. Undergraduate students who enrolled in programs have a different educational levels from matriculation, higher school certificate, and diploma and also come from different majors. This situation produces challenges for educators as to how to conduct lessons effectively. It is also a problem for educators to ensure that the process of delivering knowledge is equitable and fulfils the student's needs.

Po-BL, in terms of academic knowledge, emancipated group activities and offers collaboration between students who are advanced in particular content and students who do have preliminary knowledge. Therefore, there is a need to continuously ferment the application of Po-BL to help students to not only develop their academic knowledge but also allow them to nurture their soft-skills. In fact, the application of Po-BL can prosper to other disciplines especially in the art and humanities subjects as it will spark new teaching methods and excitement in 'book-based content' knowledge that is perceived as difficult and where it is hard to engage students in effective teaching and learning contexts. Therefore, it is found that involvement in Po-BL, which incorporates both the tranquil and turbulent process of learning experiences, could assist students in many ways and optimize student potential and talent. Whilst academic performance is not the ultimate outcome driver for Po-BL, the pragmatic approach of learning becomes the center of this method which ultimately continues to complement the education curriculum.

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