

EXPERIENCE OF STUDENTS IN PROBLEM-BASED LEARNING FOR SCIENCE IN A SABAH SECONDARY SCHOOL: PRELIMINARY FINDING FOR A CASE STUDY

Lai Kian Hua*, Mohd. Zaki Ishak, Christina Peter Ligadu
Faculty of Psychology and Education, Universiti Malaysia Sabah,
88400 Kota Kinabalu, Sabah, Malaysia

lai_kian_hua_dp20@iluv.ums.edu.my, movolk@ums.edu.my, & ligadu@ums.edu.my

Published: 26 July 2023

To cite this article (APA): Lai, K. H., Ishak, M. Z., & Peter Ligadu, C. (2023). Experience of Students in Problem-Based Learning for Science in A Sabah Secondary School: Preliminary Finding for A Case Study. *Jurnal Pendidikan Bitara UPSI*, 16, 123–135. <https://doi.org/10.37134/bitara.vol16.sp2.12.2023>

To link to this article: <https://doi.org/10.37134/bitara.vol16.sp2.12.2023>

ABSTRACT

Problem-based learning (PBL) is an alternative to conventional teaching methods for students to learn through real-world issues. The study aims to explore the PBL approach (as suggested in Malaysia Education Blueprint 2013-2025), which is students centered and has been employed in real-life settings. From the literature, students who learn through PBL possess the characteristics of self-directed and self-regulated learners who can collaborate and cooperate in learning. The background is contextual, which promotes students' motivation. As a result, students acquired 21st-century skills (21CS) consisting of cognitive, intrapersonal, and interpersonal domains. The author is interested in exploring the process of PBL via the Water Vision Program and the characteristics of students who learned through the PBL process. A qualitative case study was conducted using semi-structured interviews. The participants were a teacher as facilitator and two students who were involved with the Water Vision Program. The data underwent thematic analysis, and three main themes emerged: the learning process through PBL, challenges, and student development.

Keywords: Problem-Based Learning (PBL), 21st Century Skills (21CS), Cognitive, Intrapersonal, Interpersonal Domains

INTRODUCTION

Due to this reason, science has become more and more important these days. Furthermore, science education is facing fierce challenges economically and socially, changes are inevitable, and it is happening (Trna & Trnova, 2015). Three major concepts have been put forward for the changes in science education: awareness, the importance of interdisciplinary education from the science contexts, and how to trigger and nurture scientific interest in real-life, daily activity, or the environment. Science is influencing the job market globally. Scientific literacy is the term used globally by educational institutions to illustrate and describe an individual's science-related abilities to benefit the economy, society, and nation (Al Sultan et al., 2021).

Considering the above studies, the objective of the science subject in the Standard Based Curriculum for Secondary Schools (KSSM) for Form 4 and Form 5 (SPM) has been apparent. It states that, through the inquiry approach, dialing up students' curiosity and interest in science, enhancing their knowledge through connection with daily events and application of scientific knowledge. Problem-solving and decision-making skills have been highlighted (Bahagian Pembangunan Kurikulum, 2019). Furthermore, research shows that problem-based learning (PBL) is very effective in knowledge retention (due to the process of PBL) and also superb in knowledge application in real-life situations (Yew & Goh, 2016).

While the world is developing rapidly in technology, teaching science also needs to revolve around the development of technology (Yorkovsky & Levenberg, 2021). Emphasis is also on the connection between what has been learned in science (scientific literacy) and real life. There should not be any separation between studies (knowledge and thinking skills) and applying what has been studied into the daily application for the development and welfare of surrounding society. The author noticed that, in the PBL environment, students find the connection between "textbooks" and the actual surrounding world. Conversations between students and teachers involved in PBL give the insight that students can apply what they learn in the classroom to real-life situations. According to Montepara et al. (2021), PBL enables students to apply their knowledge (which is the information they had learned) to their practices (which are real-life situations). According to Lonergan et al. (2022), PBL has been adopted more frequently for secondary school because PBL can enhance or encourage students to apply their knowledge in solving real-world problems.

Water Vision Program had been held every year since 2007 across schools in Malaysia. It is a collaboration between Malaysia Nature Society and Coca-Cola Malaysia, with the support of Malaysia Education Minister. The main aim of the program is to inculcate awareness among students toward the conservation and sustainability of clean water. Since the launching of this program, it has become a platform for students to voice their opinions and ideas while joining hands to conserve and sustain the clean water supply in our country (Malaysia Natural Society, n.d). A secondary daily school around the Kota Kinabalu area has been engaged with the problem-based learning Water Vision program for a few years in a row. The students involved themselves with PBL in the Water Vision program, dealing with real-life problems (water pollution issues). Being that it is called Water Vision, the program has something to do with water. In the program, the students form a group, and they work as a group to solve an authentic issue related to the theme which been given for that year. The school which has been selected as the site of this research, had been involved in the Water Vision Program since 2012.

STATEMENT OF PROBLEM

Students who learn through PBL possess the characteristics of self-directed and self-regulated learners who can collaborate and cooperate in learning. The setting is contextual, which promotes students' motivation. As a result, students acquired 21st-century skills, which can be viewed from three domains which are cognitive, intrapersonal, and interpersonal (Haug & Mork, 2021; Wright & Lee, 2014). Deep learning, computational and information literacy, adaptability, creativity, critical thinking, systems thinking, and problem-solving are examples of cognitive skills (or cognitive domain). Communication, cultural sensitivity, leadership, and teamwork are examples of interpersonal non-cognitive skills, which enable an individual to relate to others. Persistence, self-efficacy, time management, and work ethic are examples of intrapersonal non-cognitive skills.

Due to the evolution of the nature of the job market, which has been influenced by automatization, digitalization, and globalization, 21st-century skills are the competencies and attributes of current and future citizens (Webb et al., 2018). The education model, which has been structured for the industrial-nineteenth century, is no longer capable or suitable for developing global citizens in this interconnected world (precariously changing) that demands a new type of self-management and skill set (McPhail, 2020). The current global education is on transformation, equipping students with 21CS that enable them to cope with the complexity of current society – by utilizing their knowledge to solve real-life problems (Haug & Mork, 2021). It is shifting from the old three R's (reading, writing, and arithmetic) to the new three R's (rigor, relevance, and real-world skills) (Teo, 2019).

Many pieces of research show that PBL contributes to developing 21SC among learners. Sebatana and Dudu (2021) found that implementing PBL in science (chemistry) enhances communication and critical thinking skills. The findings have been supported by Aslan (2021) and Lonergan et al. (2022). According to Aslan (2021), students who learn through PBL from live online classes show better achievement in learning, acquire a better and higher level of problem-solving skills, and have more communication during classes. Another similar finding by Lonergan et al. (2022) shows that students who go through PBL possess better topic knowledge and problem-solving skills. Students also show better self-regulation to obtain learning goals.

On top of the above research, Montepara et al. (2021) found that pharmacy students in Italy who participated in PBL would like to participate in PBL if they were given a chance. The study's finding shows that the students benefit from PBL for their professional development through collaboration with pharmacy students from other countries. Through this activity, through the reflection from the students, they can apply what they have learned to real-world situations (simulation for their future practices). The study also allowed PBL to be intergraded into Italy's pharmacy school curriculum, which shed light on the research that will commence. The findings will likely encourage more teachers in this country (especially in Sabah) to embrace PBL.

It is essential to understand the process of PBL, which take place in a secondary daily school setting, which is very different from the PBL in the literature, which took place in higher education from a different field that prepared their students to become professionals. The intention is to provide rich data for educators who serve at the secondary school level, especially in science, to understand PBL better and embrace PBL in the teaching and learning of science.

OBJECTIVE

The objectives of this study are to carry out a case study to explore the problem-based learning process, the characteristics of students which will be formed through the process, the interaction between teachers-students and students-students, and the impact of interactions with students. Particularly as follows:

1. To determine the process for teaching and learning in PBL via Water Vision Program.
2. To determine the formation of students' characteristics due to these processes in PBL via Water Vision Program.

METHODOLOGY

Qualitative case study research will serve as the primary methodology for this study. The author will rely mainly on the definitions offered by Merriam (2009), Stake (1995), and Yin (2011). Like the other type of qualitative research, case study research is in search of meaning and understanding, the primary instrument of data collection and analysis is the researcher, an inductive investigation strategy, and the end product will be richly descriptive (Merriam, 2009).

Research Site. The selection of the research site (decision of where the research will be conducted) is an essential part of the research method. The site to conduct the study is situated in a school around the area of Kota Kinabalu, Sabah. The school participated in the Water Vision program as a platform for problem-based learning for a selected group of students. Written permission from *Bahagian Perancangan dan Penyelidikan Dasar Pendidikan KPM, Sektor Pengurusan Sekolah JPN Sabah*, and also the administrator from the school is needed to access the school.

Participants. For qualitative research, "purposeful selection" (purposive sampling) is a strategy where the selected (not a sample at all) people who are unique, who are informative, experts in an area, or privileged witnesses to an event. Such a selection of times, settings, and individuals can provide the information needed to answer the research questions (Maxwell, 2013; Yin, 2011). For this preliminary study, the participants selected for this preliminary study were one teacher facilitator and two student participants who participated in the PBL via Water Vision program. With this, the teachers and students can give the information needed to answer the research questions.

Data Collection Methods. This research will adopt semi-structured interviews. Semi-structured interviews have the following strength: 1. They can uncover unknown issues, which structured interviews cannot uncover. 2. By probing and clarification, it can address a complex topic. 3. Ensuring coverage of all critical points for all participants, additional views (bigger picture, extra concerns or issues) can be raised by the participants and interviewers. 4. There is flexibility for interviewers to have conversations with interviewees. Therefore, comparisons can be made across interviews (Wilson, 2014).

Data Analysis. The data from interviews be transcribed into text to be analysed. The researcher engaged in the following data analysing processes: organizing the data, reading and memoing, describing, classifying, and interpreting data into codes and themes, interpreting the data, and representing and visualizing the data (Creswell, 2013). Coding and categorizing have been considered the heart of qualitative data analysis. The process involved aggregating the data into a few minor categories of information by assigning a code (a short form of the word). These small categories of information are then reduced and combined to form three themes for writing the narration (Creswell, 2013).

PRELIMINARY FINDING

Three themes emerged from the preliminary data through the semi-structured interview: the learning process through PBL, challenges, and student development.

Theme 1: Learning Process Through PBL

The learning process of PBL is the strategy of implementation, student-centered learning, cooperative and collaborative learning, teacher as facilitator and scaffolding, technological environment, real-life environment, and involvement of supportive school management.

The strategy of implementation. PBL via Water Vision Programme provides the platform and opportunity to work with a genuine real-life issue, extend and develop their knowledge into their surroundings, and actively interact with the community, surrounding schools, private organizations, and government agencies. Before implementing the PBL process, students were selected to form a Water Vision team of 8 students. Students decided whether to join or not join the program.

"...teachers pick several students, they have the choice to join it or leave it... at first, I wanted to decline it, because I never heard of this Water Vision" (Sam)

After the formation PBL team, the students were given an authentic real-life problem. For three consecutive years, the theme has been about marine debris. Moreover, the issue for the year 2022 was plastic. The students started with the exploration process once they received the theme and the issue, which had been decided by the Water Vision program of the year. At the beginning of the program, students needed to possess more knowledge and information regarding the issue or problem they would face.

"no ... I did not know what are type one plastic and type two plastic. I just knew that they are plastic." (Sam)

From the formation of the PBL group, the author dealt with authentic real-life issues, figured out the solution, organized a program to create awareness through a series of activities, and eventually achieved his development through the process of PBL and overcoming the challenges. The solution for the problem was to create awareness among as much population as possible, from within the school, to the surrounding communities. It spread wilder through social media via short videos.

Real-Life Setting. Problem-based learning via the Water Vision program uses authentic real-life issues as the subject matter, and the learning environment is a real-world setting. The primary issue was marine debris, and the problem to be solved was plastic waste. Students from the Water Vision team studied plastic waste and came up with a solution to the problem.

"...they need to think on the problem, about the plastic used, the single plastic used, which is more related to the marine debris la." (Viana)

The PBL process took seven months to be completed, and the process was not confined to a specific time in a day or week. It was something other than what the students experienced in the classroom as usual. The learning environment and location are also not restricted to the school compound and classroom.

Student-centered Learning. Since forming the PBL group for the Water Vision program, students have been left with minimum teacher help to endure the problem-solving process. Once the real-life problem with the issue of plastic waste was given to students, they started their journey of PBL, depending on themselves.

"...we sendiri (ourselves) have to think about it... I just search Google." (Aina)

Students took active roles in the learning process, while the teacher only monitored and provided very little assistance in ensuring students progressed.

Cooperative and Collaborative Learning. PBL provided a platform for students to work together in a group, which was formed by the suggestion and selection of teachers. Students had the option to join in or not. Because once they join, they must commit themselves until the end of the program because the program provides students with a new type of platform for learning. Students who joined need to play their role in contributing to the success of the Water Vision team. The team's functioning depended on the organization of the students themselves. Every student must actively participate to ensure the team moves and progresses.

"Everyone must be joining in, if not, it is not fair, and don't act like a parasite la." (Sam)

For the group to work together as a functioning team, it is crucial that they were able to communicate and build up trust and rapport. Therefore, the team went through a process that built up a harmonious working environment between the team members.

Besides the cooperation between the group members, the learning process also encompassed collaboration with other organizations, such as primary schools and government agencies which are part of their learning process. The collaboration with nearby primary schools to create awareness among primary school students. According to Viana:

"...involve with primary school... because we need to engage with the primary school as well."

Teacher as Facilitator and Scaffolding. Teachers need to facilitate the whole process during the implementation of PBL, which takes seven months, starting in March and ending in September. The facilitator's role as a teacher in the Water Vision program was broader than knowledge and attaining learning goals. It is also to ensure the group was able to perform their task.

"...they don't know what they should focus on... or what they should do... what are your progress, ah... something like that. Just everything in the group la... they do the calling, it is ok we ne ne ne ne ne... something like that, but I will just sit next to them" (Viana)

While students were working on the issue and figuring out the program and activities, the teacher needed to monitor the progress and provide guides when necessary. It ensured students worked the issue in the right direction and acquired the information to attain the intended outcome.

"...the teacher is really a great help because we are really confused and lost. Many times, during the process. Because it is all new kan." (Sam)

Technological Environment. The presence of telecommunication technology also changed the way students organized themselves. For instance, the activities such as meetings and discussions have traditionally been done face-to-face. Now, it can be done through Google Meet and Telegram. Viana shared her experience with the Water Vision program in the early year. Without telecommunication technology, all the meetings and facilitation had to be done face to face. Therefore, meeting the Water Vision team consumed a lot of time. With the presence of technology, the process, such as meetings and facilitation, becomes more time-saving, which benefits both teachers and students.

"But, nowadays, we have like Google Meet, we have Telegram, so is much more easier la... in 2020, until now, most of the discussion through Google Meet la. And Telegram... after that, I never, we never, we never overnight in school la." (Viana)

The presence of technology also changes the way students search for information and gain knowledge. From teachers, libraries, books, flyers, journals, and other printed material to searching or exploration via the internet.

Theme 2: Challenges

While PBL took place via Water Vision Program, a few issues rosed up and became challenges the participants needed to handle and get over. The challenges are uncooperative group members, a packed schedule, lack of teacher facilitators.

Uncooperative Group Members. Uncooperative team members or team members who were not entirely devoted to the group caused challenges and difficulties for the Water Vision team. As Sam said:

"Uncooperative team members, when they don't want to do the job and they all jobs toward a student or someone else. Because they don't want to do it. Or they have excuses... like slow Wi-Fi... they don't have the resources to do it..."

Some team members gave all sorts of excuses to avoid taking up responsibility as a team member. They should have carried out their learning tasks, causing extra burden to the other team members. When they were supposed to search for information or join an online meeting, excuses such as slow internet services or no resources were given and no full cooperation.

Packed Schedule for Students. The Water Vision program demanded students' commitment, especially from the aspect of time. When students embarked on the journey of PBL via the Water Vision program, they were expected to do self-learning with self-regulation and self-direction.

"She just gives us information papers from the internet, from there we look at it, and we did more into it la. Research more about it." (Sam)

The PBL process, which took place in a government secondary daily school setting, needs to allocate more time for students to engage with the Water Vision program while they had to engage with PBL's setting. The process occurred while students engaged with the regular schooling schedule, extra co-curricular activities, every typical schooling day's homework for every subject, and even upcoming school examinations.

"...we also have other activities other than this." (Aina)

PBL process which took place couldn't always be fitted into ordinary schooling time. The students who joined PBL via Water Vision program did not have separate learning program from the other students. They still need to go through all the normal routine. Aina explained:

"...because in school is very hard for us to bincang (discuss)... we also have other activities other than this."

PBL process demanded a large amount of time to be spent on planning, learning, researching, and carrying out the planned activities, to reach the learning goal.

Teacher's Commitment as Facilitator. Teacher facilitator is an undisputed element while implementing PBL via the Water Vision program. Teachers assumed the role of facilitator to guide students through the process and provided guidance and advice while students faced obstacles. Despite the vital role of teachers as facilitators, it was hard to get them to engage in the facilitators' role for the Water Vision program.

"...they need to stay back. They need to stay back because they are in the afternoon, and they are in the morning... because of my time and their time is not... you know, we are in the different session, so... normally, if really... if really need to meet them, then, we set a day, a time at night, just like this." (Viana)

Due to the nature of PBL via the Water Vision program, which was so time-consuming, the lack of teachers willingly took the role of facilitators nor got involved with the Water Vision program. Further explained by Viana:

"And normally I will be alone. There are a few teachers been in between, but, erm... at the end you know... still me alone with the students."

Getting committed teachers to facilitate the PBL via Water Vision Program will be a challenge to overcome.

Theme 3: Students' Developments

Students' development can be viewed from three aspects. For instance, competencies, character qualities, and foundational literacies. The attributes of competencies are critical thinking and problem-solving skills, creativity, communication skills, and collaboration. Students' character qualities can be viewed as adaptability, curiosity, initiative, leadership, and persistence. Literacy development, information communication technology (ICT), financial, and scientific literacy are the attributes of foundational literacies.

Competencies. Student development from the competencies can be seen in critical thinking and problem-solving skills, creativity, communication skills, and collaboration. Critical thinking and problem-solving skills are coming up with a solution to solve a real-life issue at the center of PBL. Thus, the Water Vision program provides students with a platform specifically aimed at critical thinking and problem-solving skills. The theme was "Marine Debris" and the issue which been highlighted was "Plastics" as plastics contribute to the debris that humans "contributed" to marine.

Critical thinking and problem-solving skills. Solving a real-life issue is central to PBL via Water Vision Program. Since the theme was "Marine Debris", the PBL team needed to think critically about the issue and suggest products, programs, or activities dealing with the plastic waste polluting the marine system. Analyzing the issue of plastic took place immediately.

"...the problem, about the plastic used, the single plastic used, which is more related to the marine debris." (Viana)

Then, the team conducted a series of activities to heighten the awareness and raise the knowledge about plastic recycling as the answer to plastic waste issues. The process develops students' critical thinking and problem-solving skills.

Creativity. This can be seen from a few aspects throughout the program. From the activities held to the production of a video to communicate the message is the trail of evidence of creativity development. To educate the public, it took the challenge to the next level to the Water Vision team.

"...we need to think of activity luar biasa (out of the box) punya. Me and my team balik balik fikir (keep on thinking for) idea, fikir (thinking for) idea" (Aina)

"...organising a competition within our school students, we held a pertandingan pengumpulan pastic (plastic bottle collecting competition) bottle..." (Sam)

By introducing recycling for plastic material, especially type 1 and type 2 plastics, the message of marine debris was included and transferred to the students and community. They also taught the audient how to actively get involved with plastic recycling, which can generate money from the stuff they usually throw away while reducing marine debris.

Communication skills have been sharpened through the group work through forming the Water Vision Team, communications with State Forestry Department, GNC recycling company, organizing

recycling campaign within the school, conducting activities with a primary school, and even within the PBL group.

"...me and my friend tell dia (him), you need to help us, we as a team need to do beginigini (like this like this)... so, we can like kasih siap awal gitu (get it done earlier)... finally he give commitment." (Aina)

Collaboration. Water Vision Program provides a platform for students to work with other schools, private company, and government agency. The skill of collaboration been developed through working with other parties to handle the issue of plastic waste, which contributes to marine pollution. Students need to create awareness within the community in which they are living. They collaborate with one of the primary schools by conducting programs and seminars for primary students.

"...where we do ceramah (workshop) there, so we talk to the community and we do some competition, meaning competition for the kids, for primary school kids..." (Aina)

Collaboration has been formed not only with primary school. The Water Vision Team took a step further to expand their boundary by involving a private recycling company - GNC, and Sabah State Forestry Department.

Character qualities. Students' character qualities development can be observed in adaptability, curiosity, initiative, leadership, and persistence. Adaptability. Students need to adapt themselves to the type of group members that they were grouped with. Overcome the emotional challenge by adaptation and finding a way to work with group members.

"Uncooperative team members, when they don't want to do the job and they all jobs toward a student or someone else. Because they don't want to do it.... I used to get angry, a lot... because of my members..." (Sam)

Besides adapting with people, students also need to adapt to the challenging learning environment the program demands from them. According to Sam:

"...when the activities, project was going on, we have upcoming exams, and many PBL, so, sometimes I will stay up very late, like until one o'clock to finish my homework, my study and of cause the project."

Facing the extra challenging and packed schedule were the new circumstances that students need to adapt to.

Curiosity. Students develop curiosity through the PBL process. Their urge to know more intensify after joining the Water Vision programme. According to Aina:

"Sometimes I ask my friend, or I ask teacher, or I just search google, I want to get involve with activity macam ini (like this). So like, learn more, learn harder, so that I can involve lagi (again) in this kind of activities."

Curiosity, wanting to know more and learn harder is an impact of PBL via the Water Vision program on the students. From only knowing plastics and only "plastics" to know that there are different types of plastics. According to Sam:

"I did not know, what are type one plastic and type two plastic. I just knew that they are plastic."

Further, where these plastics feature in our daily life, collecting things like "waste" can generate income while reducing marine debris, causing students to open their eyes and be more sensitive to their surroundings.

Initiative. PBL via Water Vision program varies from the ordinary classroom setting, whereby teachers initiate the learning process in normal classrooms. Contrarily, the Water Vision program allows students to conduct the activities, program, and content by themselves. They were not given specific

instructions on the activities to be conducted, how the activities were going to be conducted, they were not given any information to study, or where to get the information to solve the problem given to them.

“They’ve their own, before they came back to me.” (Viana)

Students initiated the ideas. Before the executions, the teacher only acts as a facilitator by giving comments to improve the ideas.

Through leadership within the Water Vision's PBL group, students' initiative has been developed. Besides deciding on the activities to do, students also needed to lead their team members when the team did not function as a team. Students step up to the situations to lead the PBL team out of a dysfunctional team. When members needed to cooperate fully to ensure the team progressed properly, members within the group took the lead to ensure everyone contributed as they ought to. Leadership was cultivated when the team was in crisis.

“...we talk it out... like a group discussion, on why should we not be malas (lazy)... we have to do it, everyone have to be cooperative.” (Sam)

Persistence. Giving up was at the edge at every point throughout the PBL process. Students need to cope with excessive pressure throughout the process of PBL. By comparing themselves to the other students, they need to handle extra learning activities. Sam described:

“So, I was scared maybe it was hard... maybe I couldn’t do it, maybe the pressure was great or maybe I thought I will give up halfway...”

Joining PBL via the Water Vision program caused enormous pressure on her because she never experiences something like that beforehand. Giving up came to her mind even before the process started. Busy schedules and a heavy load of other activities faced by students could easily break the progress of PBL via the Water Vision program.

“...while our project is going on, there are like upcoming exam... PBL, that is the one thing like real-life pressure a lot. And then I am also a ketua kelas (class monitor), I have extra responsibility that I need to handle.” (Sam)

“Because need to focus academic and then, need to focus this Water Vision lagi... and teachers pun (also) like giving many homework, susah la mau (hard to) do all this things. Ada juga (additionally), our program itu (that), ngam ngam (exactly) the next week tu (that have) exam.” (Aina)

Despite all the pressures from all directions, such as tight schedules, packed activities, the stress of working with people they need to become more familiar with, and uncooperative, students in Water Vision Team prevail by persistence and achieving the learning goals.

Foundational literacies. The development of foundational literacies can be viewed from literacy, information communication technology (ICT), financial, and scientific literacy. In literacy development, students generally need to communicate effectively and make sense of their surroundings (the world). Therefore, they need to acquire and develop the skills such as reading, listening, speaking, and writing. PBL, via the Water Vision program, inculcate literacy in students. Reading skills were developed while they read and went through a range of information to gain new knowledge regarding plastic. Through reading, their understanding of plastic had expanded.

“They are two different kinds of plastics, type one plastic consists of water bottle plastics, like biasalah (normally) water bottle punya (the one) plastic and gas drink, type two plastic are like those sabun cuci kain punya (the one detergent for cloth washing) bottle.” (Sam)

Reading and researching through browsing information from the internet were the processes that students went through while searching for new understanding. The processes cultivated students' literacy in reading. The other skills which had been developed were listening and speaking skills.

Attending seminars and conducting workshops were part of the content of the Water Vision Program. Sam shared her experience of attending a workshop conducted by the Sabah Forestry Department:

"...talk about mountain, and then he talked about trees, and then type of species, flora fauna those..."

The process of acquiring and spreading knowledge (awareness) happened simultaneously in PBL. These processes inculcate all these skills as a package.

Students' ICT literacy has been advanced through the massive application of ICT literacy in the process of PBL. The integration of ICT can be seen in searching for information via the internet, holding meeting via Google Meet and discussions via the Telegram application, producing videos, and communicating with the online community via Facebook. The integration and application of ICT tools get little attention from students in ordinary classrooms. PBL provided the students with the environment and chances to integrate this application into their learning process.

Coming to the end of the Water Vision program, students produced a video that summarise the whole learning process.

"...we tell la through the video... and the video at the same time can spread awareness to others. What we do and what we can do to selamat alam sekitar begitu (save the environment, like that)." (Aina)

Video production demand ICT literacy. Hence, students' literacy in this area been inculcated. The video has been broadcast through Water Vision's Facebook page to reach more vast numbers of netizens to achieve the goal of spreading awareness.

To conduct a workshop in a primary school, transportation and providing materials for primary school students for a workshop require a certain extent of financial assistance and planning. By doing this, it exposes students to the idea of fund management and fundraising. According to Aina:

"The plastic we sell it to the GNC, then the money collected we used for our other programs."

Students learn how to gather and manage funds for the benefit of other programs. This hands-on opportunity allowed the student participants to be exposed to financial literacy. Aina continued to explain:

"We buy things for the gifts begitu (something like that), for the competition punya gift."

Financial literacy has been cultivated by collecting and selling used plastic and allocating the fund for other usages.

Scientific literary development is observed when students dissect the plastic issue related to the theme "marine debris". The Water Vision Team asks, understands, finds, and interprets the facts regarding plastic and marine pollution while searching for answers to address the issue.

"Mula-mula tidak tau juga, tidak tau itu benda (initially I also don't know, what's the thing), but and then from there I can learn, then after I learn then I tell other people juga la." (Aina)

Students started to work on the issue of plastic without knowing there are several types of plastic. According to Sam:

"Oh, no, I did not know, what are type one plastic and type two plastic. I just knew that they are plastic." (Sam)

Students went through the process of asking what " plastic " contributes to "marine debris", seeking to understand the types of plastic, looking for the source of all these plastics waste, and finding solutions from the fact that they found.

DISCUSSION

Research Questions 1: What are the teaching and learning processes in PBL via Water Vision Program?

This study's first objective is to explore the teaching and learning process in PBL via Water Vision Program. Theme 1 summarized the informants' narratives of the learning process through PBL. For instance, the PBL used an authentic real-life issue as the subject matter is supported by Lonergan et al. (2022). The major characteristics of PBL, the environment is real-world, and the issue is authentic. The Water Vision Program provides students with a platform to interact actively with the surrounding environment and communities. The authentic issue of plastic is also closely related to their everyday life, not beyond their imagination.

The informants also reviewed that PBL is student-centered. They are supported by Kwan (2019), where PBL is established and a well-known pedagogical approach that is student-centered. Students decide on what knowledge to acquire, how, and when to acquire it. Students are central to decision-making, time management, and content selection.

Findings show that cooperation and collaboration between students are very much needed during PBL. The findings are supported by Chen and Kuo (2019). Group work through group formation supports collaborative interactions among the group members. Water Vision Program is done through group work. Students were provided with opportunities to cooperate and collaborate when the Water Vision Program was conducted.

Research Questions 2: How do these processes enhance the formation of characteristics of students?

The second objective is to explore the formation of students' characteristics due to these processes in PBL via Water Vision Program. Some findings in Theme 2 reveal the challenges faced by students while joining the Water Vision Program. Theme 3 described the students' development after they went through PBL via Water Vision Program.

The finding revealed that when students work together in a PBL group, sometime, there will be uncooperative group members. When students faced uncooperative group members, communication skills, adaptability, and leadership were needed to keep the group working together toward common goals. Chen and Kuo (2019) confirmed that group members affect the learning performance and interaction of the learning group for PBL. Because group members need to find a way to work with everyone, they need to adapt and communicate. Leadership is shaped when they try to lead and influence the uncooperative group member to contribute to the group's success.

Theme 2 also reveals that students need to work around a very tight and packed schedule. The PBL via Water Vision Program is not a program constructed into the existing secondary school curriculum. The program has been encouraged, promoted, and held as a competition by the Ministry of Education (MOE) on top of the existing curriculum to inculcate PBL practice in schools nationwide. Theme 3 reveals that persistence and ICT literacy have been found in students. Seibert (2021) confirmed that PBL can foster perseverance in students. Despite the tight and stressful environment, the nature of PBL, which promotes students' active engagement as a learning group, enables them to persevere. The ICT-bounded environment fostered ICT literacy while easing communication between group members.

IMPLICATION OF FINDINGS

The participants for this preliminary study are two students and a teacher facilitator from a daily secondary school in Sabah. The findings show the developments inculcated in students via the Water Vision Program and the importance of the teacher's role as a facilitator in contributing to the success of PBL. The findings reflect the real scenario regarding the implementation of PBL in a secondary daily school setting. Therefore, the school administrators, district education offices, state education departments, and the Ministry of Education need to provide proper training to prepare teachers as PBL facilitators. Ensuring teachers are highly skilled in giving proper guidance to students during PBL.

Moreover, students experienced developments in competencies, character qualities, and foundational literacies through PBL via Water Vision Program. This process can develop students into a workforce that is required for 21st-century citizens, with attributes such as perseverance, initiative, communication skills, and creativity. Therefore, students should embrace every chance to join a PBL program. School administrators are encouraged to plan and include PBL as a learning approach in their year lesson plan for every subject. To ensure that students across the nation enjoy the benefit of PBL.

The findings of this research might act as a guideline or reference for future researchers to investigate PBL from the aspect of the implementation process, teachers' role as facilitators, and students' development. More research should be done to shed light on the implementation of PBL in the setting of Malaysia's secondary schools to improve the likeliness of school teachers embracing PBL as the learning approach.

CONCLUSION

This preliminary study adopted a qualitative case study through individual interviews to explore the implementation process of PBL via the Water Vision Program and the formation of students' characteristics through the process of PBL via the Water Vision Program. Results show that the main challenge faced during the implementation of PBL was the packed schedule faced by students. Students found that PBL is very interesting because it involves interaction with the surrounding community and working with a real-life issue. Through the process of PBL, students experienced development in competencies, character qualities, and foundational literacies. Finally, future research should involve more informants and adopt more data collection methods, such as focus group discussions and document reviews, to provide deeper insight and richer data.

REFERENCES

- Al Sultan, A., Henson, H. J., & Lickteig, D. (2021). Assessing preservice elementary teachers' conceptual understanding of scientific literacy. *Teaching and Teacher Education*, 102, Article 103327. <https://doi.org/10.1016/j.tate.2021.103327>
- Aslan, A. (2021). Problem-based learning in live online classes: Learning achievement, problem-solving skill, communication skill, and interaction. *Computers & Education*. 171, Article 104237. <https://doi.org/10.1016/j.compedu.2021.104237>
- Bahagian Pembangunan Kurikulum. (2019). *DSKP KSSM SCIENCE FORM 4 AND 5*. Putrajaya: Kementerian Pendidikan Malaysia.
- Chen, C. M., & Kuo, C. H. (2019). An optimized group formation scheme to promote collaborative problem-based learning. *Computers & Education*. 133, 94-115.
- Creswell, J. W. (2013). *Qualitative inquiry & research design: Choosing among five approaches*. (3rd ed.). SAGE Publications, Inc.
- Haug, B. S., & Mork, S. M. (2021). Taking 21st century skills from vision to classroom: What teachers highlight as supportive professional development in the light of new demands from educational reforms. *Teaching and Teacher Education*. 100, Article 103286. <https://doi.org/10.1016/j.tate.2021.103286>
- Kwan, C. Y. (2019). A thorny path: the developmental course of problem-based learning for health sciences education in Asia. *Advances in Health Sciences Education*. 24, 893-901.
- Lonergan, R., Cumming, T. M., & O'Neill, S. C. 2022. Exploring the efficacy of problem-based learning in diverse secondary school classrooms: Characteristics and goals of problem-based learning. *International Journal of Educational Research*. 112, Article 101945. <https://doi.org/10.1016/j.ijer.2022.101945>
- Malaysian Natural Society. (n.d.). *MNS & Coca-Cola Water Vision Programme*. Retrieved July 3, 2023, from <https://www.mns.my/mns-coca-cola-water-vision-programme-2/>
- Maxwell, J. A. (2013). *Qualitative research design: an interactive approach*. (3rd ed.). SAGE Publications, Inc.
- McPhail, G. (2020). Twenty-First Century Learning and the Case for More Knowledge About Knowledge. *New Zealand Journal of Educational Studies*. 55, 387-404. <https://doi.org/10.1007/s40841-020-00172-2>
- Merriam, S. B. (2009). *Qualitative research: a guide to design and implementation*. John Wiley & Sons, Inc.
- Montepara, C. A., Woods, A. G., & Wolfgang, K. W. (2021). Problem-based learning case studies: Delivery of an educational method and perceptions at two schools of pharmacy in Italy. *Currents in Pharmacy Teaching and Learning*. 13(6), 171-722. <http://dx.doi.org/10.1016/j.cptl.2021.01.026>

- Sebatana, M. J., & Dudu, W. T. (2021). Reality or Mirage: Enhancing 21st-Century Skills Through Problem-Based Learning While Teaching Particulate Nature of Matter. *International Journal of Science and Mathematics Education*. 20, 963–980. <https://doi.org/10.1007/s10763-021-10206-w>
- Seibert, S. A. (2021). Problem-based learning: A strategy to foster generation Z's critical thinking and perseverance. *Teaching and Learning in Nursing*. 16(1), 85-88.
- Stake, R. E. (1995). *The art of case study*. SAGE Publications, Inc.
- Teo, P. (2019). Teaching for the 21st century: A case for dialogic pedagogy. *Learning, Culture and Social Interaction*, 21, 170-178.
- Trna, J., & Trnova, E. (2015). The current paradigms of science education and their expected impact on curriculum. *Procedia - Social and Behavioral Sciences*. 197, 271-277.
- Webb, M. E., Prasse, D., Phillips, M., Kadjevich, D. M., Angeli, C., Strijker, A., Carvalho, A. A., Andresen, B. B., Dobozy, E., & Laugesen, H. (2018). Challenges for IT-Enabled Formative Assessment of Complex 21st Century Skills. *Technology, Knowledge and Learning*. 23, 441-456. <https://doi.org/10.1007/s10758-018-9379-7>
- Wilson, C. (2014). *Interview techniques for UX practitioners, a user-centered design method*. Elsevier Inc.
- Wright, E., & Lee, M. (2014). Developing skills for youth in the 21st century: The role of elite International Baccalaureate Diploma Programme schools in China. *International Review of Education*. 60, 199-216.
- Yew, E. H. J., & Goh, K. (2016). Problem-based learning: an overview of its process and impact on learning. *Health Professions Education*, 2(2), 75-79.
- Yin, R. K. (2011). *Qualitative research from start to finish*. Guilford Publication, Inc.
- Yorkovsky, Y., & Levenberg, I. (2021). Characteristics of candidates wishing to study science and mathematics toward a teaching certificate. *Teaching and Teacher Education*. 101, Article 103282. <https://doi.org/10.1016/j.tate.2021.103282>