International Journal of Advanced Multidisciplinary Research and Studies

Application of 4C Elements in Online Project-Based Learning to Assist Students' Communication Skills Biology Subjects

[1] **Ehqa Dhabita Mohd Nasir**, [2] **Denis Andrew**
[1, 2] Faculty of Psychology and Education, Universiti of Malaysia Sabah, Kota Kinabalu, Malaysia

Corresponding Author: **Ehqa Dhabita Mohd Nasir**

Abstract

The success of communication skills through online Project-Based Learning (PBL) can be achieved when students are able to express opinions, discuss with others to find solutions, interact, dialogue, argue based on evidence and solve a problem based on the real world. In recognition of the importance of online Project-Based Learning strategies in influencing students' communication and problem-solving skills, this paper aims to synthesize the existing relevant literature to establish a theoretical foundation of project-based learning that highlights the application of 4C elements namely communication, collaboration, creativity and critical, which focuses its influence on students' communication skills and problem-solving skills. The study design was conducted qualitatively using purposive sampling method. Interview data, observations and documents were analyzed using the snowball method. Researchers selected the first case that met all the specified criteria to obtain concise data. The analysis was conducted on six respondents. In conclusion, project-based learning fulfills the key features of effective interventions for 21st century learning because project-based learning (PBL) is an educational model that prioritizes projects in teaching and learning which is also an instructional method that allows students to build skills and acquire knowledge through projects, cooperative learning and 'hands on' techniques. Through the implementation of the project, students can build knowledge and skills through the inquiry process. The integration of project-based learning strategies makes this instructional method adaptable to students of varying backgrounds, ages and levels of education.

Introduction

PBL uses a dynamic approach so that problems and challenges in the real world can be explored by students. (Moursund 1999; Gultekin 2005; Blumenfeld *et al*. 1991; The George Lucas Foundation, 2012). According to Stephanie (2010), PBL is an approach that can enhance students' 21st century skills, where these skills are critical to producing a balanced human capital in terms of spiritual and physical. However, the effectiveness of PBL cannot be implemented effectively if the elements of the PBL approach are not disclosed to students during the learning sessions. Pupils were found to be unable to apply the concepts and processes of science learned in school to their daily living practices outside of school hours when teachers relied solely on textbook content (Nordine, 2007). PBL is the right choice that teachers should take as a teaching practice in the classroom as suggested by Barak and Dori (2005). Through PBL students' knowledge and skills can be built through an inquiry process to solve any problems that revolve around real life as stated by The Buck Institute for Education, BIE (2005). 21st century learning applies the concept of 4C, namely communication, collaborative, critical thinking, creativity and also 6C with the addition of 2 elements of the application of noble values and ethics according to the Malaysian context (Pendidik2u.my, 2018). These 4C skills are an important element to ensure high quality PBL construction. A study conducted by Masyuniza and Zamri (2013) found that the six components of 21st century skills studied (communication, digital age literacy, inventive thinking, effective communication, high productivity production as well as spiritual values and norms) are still at a moderate level. Therefore, these elements need to be developed and nurtured among teachers and students to ensure the achievement of high standards. Teachers are an important element because they are the implementing agents and facilitators who need to prepare themselves in ensuring the effectiveness of a learning.

Based on the Astro awani website (https://www.astroawani.com/berita), dated 9 April 2020, in line with the Movement Control Order (PKP) implemented by the Malaysian government to curb the spread of COVID-19, an online learning method is a necessity. All schools in Malaysia have no other choice but to use online teaching and learning methods. This is important to ensure that learning topics can be presented effectively. However, not all students are able to implement online learning

systematically because they are unable to adapt to learning in the new norms. There are students who do not have internet access or technology to participate in digital learning. This gap can be seen across countries and between domestic income brackets. For example, although 95% of students in Switzerland, Norway and Austria have computers to use for their school work, only 34% in Indonesia, according to data from the Organization for Economic Co-operation Development, OECD. In the United States, there is a significant gap between those from special and underprivileged backgrounds, while nearly all 15-year-olds from special backgrounds say they have a computer to use, nearly 25% of them from underprivileged backgrounds no. While some schools and governments have provided digital equipment to students in need, such as in New South Wales, Australia, many are still concerned that the epidemic will widen the digital divide. Therefore, teachers need to diversify teaching methods to suit learning in the new norms. Teachers can use the various platforms available to ensure that the learning and teaching process can be implemented effectively. Teachers can also apply PBL in online learning.

In the face of this pandemic season, all students and teachers will implement online learning. This is to ensure that all students are not left behind in following the learning sessions and the teacher can finish the teaching topic. However, various concerns arise when wanting to implement this online teaching and learning session. This is because not all students have personal smartphones, some do not have enough internet data, some do not have direct internet access and some are unable to adapt to learning in the new norms. In addition, teachers who want to implement PBL are also worried about how to implement PBL online and most of them use the trial and error method. Not all students have the opportunity to be involved in PBL activities conducted online. Therefore, it is not surprising that there are a few students who choose to act as observers only (Siti Aloyah 2002). Whereas when all students are involved in carrying out project work hands -on learning will be more effective (Blumenfeld *et al*. 1991). The development of technology especially the evolution of the internet has challenged the concepts and theories of traditional education, especially the concept of classroom and teaching and learning methods (Hunt, 2004; Resnick and Wirth, 1996) Gunasekaran (2013) has conducted a study on blended learning that is about research and application. According to him, the existence of broadband technology will further improve the quality of online learning by using various applications. Learning will be more interactive than traditional learning.

In general, the purpose of this study was to identify how the application of 4C elements in project -based learning can help students' ability to communicate effectively and problem - solving skills in the form of KBAT for online biology subjects. According to Azalya (2003), to face the challenges of globalization, Malaysians need to be equipped with various basic skills in education and strong training and have a variety of general skills including the ability to communicate, master multiple languages, critical thinking and innovative. Based on the problem statement described in the previous section, this study aims to examine in more depth how the application of 4C elements in project- based learning can help students, especially in terms of communication skills and problem solving skills in the form

of HOTS for Biology subjects online.

Literature Review
Pupils' Communication Skills While Implementing Project Based Learning (PBL) For Biology Subjects

One of the scientific skills is communication. According to Rogers and Kincaid (in Cangara, 1998, p. 19) communication is a process in which two or more people form or exchange information with each other, which will lead to the emergence of deep mutual understanding. Based on the researchers' observations on the teaching and learning process of Biology found that teachers tend to explain the learning materials and provide explanations without using media. In biology learning, teachers usually function as informants and students as recipients of information. This causes students' communication skills to become passive and the teaching process to become a process of memorizing concepts or procedures, but at the same time Biology process skills and students' achievement are at a low level (Rose Amnah 2004). This has become even more troubling since the world was hit by the Covid-19 epidemic, teachers and students need to drastically change the methods of online learning and teaching. Pupils will continue to be observers and recipients of information during the online learning sessions implemented. If this continues, the learning sessions will become increasingly boring and students' communication skills will become passive as students will increasingly lose focus on the subject of Biology. The findings also show that the factors that cause students to lose focus are from boring learning and teaching sessions. According to Reinhartz and Beach, 1998; Wiles and Bondi, (1998) stated that concentration during a learning session is very important because a student's concentration is able to help in improving their mental intelligence. This in turn helps them to adapt, achieve success in life and always be ready to be in society in the increasingly challenging future. According to Amir Hasan (2009), in a learning environment, each student has different psychology and abilities from each other. Therefore, the planned teaching should be appropriate and arranged according to the level and environment of the students. In addition, it should be supported by the use of appropriate teaching aids to stimulate students' communication skills to the maximum level. An important element in the curriculum learning system today is the selection of appropriate teaching methods that involve students actively in learning, whether mentally, physically or socially. Teachers need to emphasize on understanding concepts, problem solving skills and provide teaching aids that are appropriate and able to attract students to follow the teaching and learning process (Depdiknas 2006; Rose Amnah *et al*. 2004).

Communication skills are an ability to establish interactions or relationships through the medium of intermediaries or vice versa with others. Good interaction between teacher and student can create a positive relationship in the classroom. The quality of social development and teaching in an organization is determined by the social relationship mechanisms built into it such as effective use of language, interaction processes, open communication and verbal skills (Rahim, 2011). However, when implementing PBL online, the nature of communication changes. The language used by students and teachers is different, work processes are different, and the relationship between teacher and student is also different. New communication strategies and

techniques must be used when implementing PBL online. The teacher acts as a facilitator and guide to develop the learning experience, not as a mere informant and instructor.

When implementing PBL online, teachers should provide opportunities for students to submit their ideas and imaginations and encourage them to participate in discussion sessions about an idea presented (Lehesvuori *et al.*, 2011). Speaking power can stimulate and motivate students to think as well as enhance students 'learning and understanding through dialogue methods (Alexander, 2006). According to Alexander (2006), dialogical teaching can improve students 'reasoning skills and comprehension. During dialogic teaching, teachers will take into account students' ideas and students are encouraged to participate in discussions about the ideas presented (Lehesvuori *et al.*, 2011). This phenomenon will trigger a culture of thinking among students and prevent students from simply memorizing the facts and concepts learned.

According to Kearney and Bandley (1990) in Nurazmallail Marni, Ahmad Kilani Mohamed, and Kamarul Azmi Jasmi (2004), stated that teamwork can improve and smooth the communication process in an organization. There are many advantages of teamwork, among them are that team members can improve their understanding of organizational goals, more effective problem solving, encouragement to be creative, increased motivation and morale, opportunities to identify and develop better leadership and communication (Zaidatol, 1990). The results of a study by Mohd Fadzli Ali, Normah Salleh and Juhazren Junaidi (2007), found that group work skills also improve communication skills through group discussion. This opinion is supported by Akindele (2012) in Mohd Akmal Masud (2013), who states that students are aware of teamwork, they can improve communication with classmates, communicate with friends of different races, and can strengthen trust between group members. However, Mills & Treagust (2003) and Siti Fatimah *et al.* (2006) argue that PBL can be carried out individually or in groups. In this case, students are given the freedom to choose to implement PBL individually or in groups. Therefore, there is a dominance of work in students who implement PBL individually. Therefore, teachers play an important role as mentors who can control the course of the teaching and learning process in the classroom for students to build knowledge through teaching activities that can improve students' communication skills. Tal *et al.* (2006) stressed that the implementation of PBL allows students to enhance their learning experience outside the classroom through meaningful questions relevant to the surrounding community. Daily life -based learning is also able to encourage students to learn actively. This is because students have the opportunity to generate their ideas, imaginations and experiences during the learning session. Therefore, students will interact with each other and ask questions to each other.

However, there are still students who implement Biology learning methods that are more focused on the conventional method of teacher -centered learning (Henderson *et al.*, 2000). Not surprisingly, therefore, there are still students who are unable to apply what they have learned to daily life. This is because teachers rely solely on the content of textbooks (Nordine, 2007). When students only focus on the content of the textbook alone, students do not have the opportunity to interact, let alone dialogue. Whereas, through

the implementation of ordinary practicals done in the laboratory can not build students' understanding (Pyatt and Sims, 2007), let alone online learning. Learning will become increasingly passive. The failure of students to build their own understanding is due to the learning methods practiced are more focused on teachers as channeling information while students are not actively seeking their own learning resources and tied to textbooks (Martinez, 2003; Middlebrooks & Slupski, 2002). Through conventional learning methods such as this, not all students have the opportunity to be involved in the activities carried out and some even choose to act as observers only (Siti Aloyah 2002). Whereas when all students are involved in carrying out project work hands-on learning will be more effective (Blumenfeld *et al.* 1991). This statement is supported by the opinion of Drew and Ottewill (1998) who found that students who fail in lessons are also influenced by the inadequacy of the learning strategies they use. Therefore, teachers are responsible in diversifying learning approaches and ensuring a conducive learning environment.

Methodology/ Method
This study was conducted based on research questions; How can the application of 4C elements in online Project -Based Learning help students' communication skills for Biology subjects? To answer this question, a qualitative study was conducted. This study also examines in depth how project - based learning can help students implement online learning, issues or challenges in implementing project -based learning online, the effectiveness of communication skills and problem-solving skills and evaluation of the implementation of PBL online.

Research Paradigm
Qualitative research is descriptive in nature i.e. the researcher is interested in the process, meaning, and understanding gained through words or observations. The process of qualitative research is inductive in nature in which researchers build abstracts, concepts, hypotheses, and theories based on a study. Qualitative research helps researchers make in - depth research through direct observation of the natural environment (Creswell, 2012: 17).

Research Design
A case study is an appropriate research design to use if the research process is about a process (Cannon 2001) because it can provide an overview or pattern for understanding the process. To explain the importance of researching processes in case studies, Sander (1981) explains that case studies help us understand the processes involved in an event, project and program and explore the features of the context that will shed light on an issue or object.

Study Determination
A school is an educational institution that provides learning and teaching facilities to students and teachers. Education in Malaysia is supervised by the Ministry of Education. Public secondary education in Malaysia is known as Sekolah Menengah Kebangsaan (SMK). Sekolah Menengah Kebangsaan uses Malay as the main medium of instruction because Malay is the National language of Malaysia, while English is a compulsory subject in all schools. Since 2003, Science and Mathematics have been taught in English, but

in 2009, the government decided to return to using Malay starting in 2012.

Study location

This study was conducted in a school in Kota Kinabalu, Sabah because this school is one of the schools that have implemented project -based learning starting in 2016. In addition, there are many facilities, especially 21st century learning facilities readily available at this school. The school has a demographic that suits the surrounding area. Thus, it encompasses a population comprising of various categories such as race and socioeconomic status. Besides, the school was also selected based on good internet facilities such as Wi-Fi connection, as well as LAN connection. This facility is seen as an opportunity to support student needs and learning.

Principal Investigator

Although the researcher has an educational background related to Biology education at the level of Bachelor of Science Education (Biology/Chemistry) and Master of Science Education (Biology), the researcher believes that the application of 4C elements in PBL can expose students to active learning experience online, if PBL strategy designed according to the needs of the student. He also believes that technology should be combined with the integration of other learning strategies to influence systematic learning outcomes. For example, the implementation of PBL needs to be applied 4C elements to encourage students to learn actively, especially while implementing online learning during this pandemic season. Researchers are also interested in understanding how teachers devise online learning strategies to produce positive learning among students using technology. The researcher also serves as one of the judges for the implementation of project- based learning at the Kota Kinabalu district level. This allows the researcher to work with the highest implementers of the State Education Department (JPN) for the implementation of PBL. In addition, as one of the teachers responsible for the implementation of PBL in the schools studied, it further facilitated the respondents to continue to consult the researcher on issues related to the implementation of PBL.

There are two main roles in this study: a) Teacher who teaches Biology subject and b) Researcher. Teachers only have the role of teaching Biology subjects, providing PBL work as well as evaluating PBL work which is part of this study (Assignment 1 and Assignment 2). In the subject of Biology, the teacher's role is to evaluate the students' PBL work based on the scoring rubric provided, analyse the results of the semester 1 examination and the students' SPM test as well as the students' PBD mastery level.

Biology Subject Description

Biology is a scientific study of life. Biology studies the structure, function, growth, origin, evolution and distribution of living things. This field focuses on the classification and description of organisms, the functions of organisms, the ways and reasons why species exist, as well as their interactions with each other and the environment. Biology subjects are based on four main principles, namely cell theory, evolution, genetics and homeostasis. The biology curriculum is organized according to several themes. Each theme contains several Learning Areas (BPs), each BP has several Learning Objectives (OPs) and each OP has one or more Learning Outcomes (LS). In total, there are 5 learning themes, 28 learning areas, 489 objectives and learning outcomes in all for the Biology syllabus form 4 and form 5. As stated in the Biology Syllabus Form 4 and Form 5, teaching and learning strategies in biology curriculum prioritize learning thinking. Thoughtful learning is a process of acquisition and mastery of skills and knowledge that can develop a student's mind to an optimal level. Thoughtful learning is able to expose students to various learning approaches such as inquiry, constructivism, contextual learning and mastery learning.

In the Biology curriculum, it is suggested that apart from teacher-guided experiments, students are given the opportunity to design experiments, i.e., they themselves design the relevant experimental methods, measurable data and how to analyze data as well as how to present their experimental results. Among the activities proposed are discussions, simulations, projects, visits and the use of natural resources as well as the use of technology. One of the proposed activities is project implementation. A project is an activity carried out by an individual or a group of students to achieve a specific goal. Projects take a long time as well as spanning formal learning time to complete. Project results can be produced in the form of reports, artifacts or others and they need to be presented to teachers and other students. Project work encourages the development of problem -solving skills, time management skills and self- learning.

ISP PBL Online Model

In this study, students are expected to conduct project -based learning that incorporates 4C elements during its online implementation. Students will carry out 3 phases of PBL. The first phase, students are divided into several groups. Each group consists of students who have differences in terms of abilities, inclinations, knowledge and experience of existing students as stated in the STAD learning Model. Next, students will be exposed to the learning objectives for the field of learning as the steps recommended in the ASSURE model. Students will also be exposed to issues related to the area of learning. Afterwards, the teacher will act as a facilitator and question the students using a set of meaningful questions created based on reference to the learning objectives and questioning techniques of 5W1H. Pupils are guided to discuss and encouraged to prepare a mind map during the discussion.

In the second phase, students are encouraged to discuss and make partnerships in groups to build products. Students will share information, dialogue and use technology. The teacher acts as a facilitator to guide the students to achieve goals and agreement in the group. Next, the third phase, students will present the results of their products. Pupils are encouraged to prepare a mind map. Students will be guided to dialogue and argue about the pros, cons and improvements of the products they produce. The presentation session was conducted using a set of questions created using the 5W1H questioning technique.
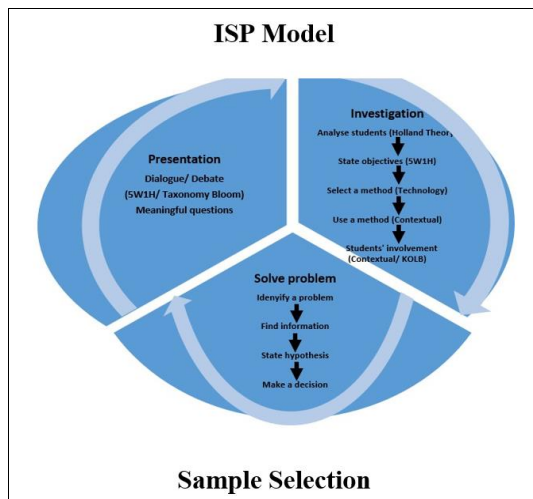
Once a case is selected, purposive sampling is performed. The initial case for this study was an upper secondary student who took a pure science stream and took Biology as an additional subject in the Sijil Pelajaran Malaysia (SPM) examination at a school in Kota Kinabalu, Sabah. There were 3 female students and 3 male students who were 17 years old. Using this method, all respondents were selected based on identified criteria; all students are positive towards the use of technology, such as computers and the internet, all individuals have their own gadgets and internet, have

experience conducting project-based learning and have achieved level 3 in Classroom Assessment (PBD). Pupils had no option to withdraw from completing two projects in data collection and analysis for this study. Nevertheless, students can still choose whether they want to engage in a focused group to be interviewed.

All these respondents were selected as a unit because one of the research questions was to look at the application of elements of collaboration, communication, creative and critical thinking in online project- based learning. For this study, diversity was determined through observations of respondents' activities while implementing project -based learning online. Therefore, the unit of analysis for this study is the online project- based learning approach and the application of 4C elements in PBL. Their experiences and perceptions of PBL were obtained through interviews, observation and analysis of academic achievement documents and classroom assessment (PBD). The figure below shows the demographics of all the respondents. A total of 6 respondents were involved in this study, namely 3 female respondents and 3 male respondents aged 17 years. They were the same group of students for the past five years, only from different classes. Codes were given to each respondent because the study used a variety of sources from each individual. Individual codes are very important when analyzing data because this information is used to see similarities or comparisons among respondents.

Table 1: Data Sources Based on Research Questions

S. No	Research Question	Data Source
1	How can the application of 4C elements in online PBL help students' communication skills for Biology subjects?	1. Observations on student activities implementing PBL online, comments, conversations, student discussion activities, student presentations, student responses, enjoyment, understanding and influence on student attitudes) 2. Focus group interviews 3. Document analysis (Level of mastery of PBD learning semester 1 and semester 2, Project marks (PBP) semester 1 and semester 2, academic achievement of semester 1 students and SPM test)

Study Procedures
In the first stage, the researcher conducted a study to identify the problems faced by the students in terms of communication skills and online problem-solving skills for the subject of Biology. The three methods of data collection used at this stage are to interview 6 informants, make observations based on the constructs set in the study on the six informants and make document analysis on academic achievement in semester 1, project marks (PBL) in semester 1 and evaluation level of learning (PBD) in semester 1 for these six. Next, the researcher will make triangulation for all the data collected. The research was conducted for 8 consecutive weeks. The implementation of the study at this stage did not involve the role of teachers because this study only focused on data related to problem identifiers.

In the second stage, the research focuses on the research question, or the preliminary theory being tested. Researchers conducted a study at this stage to see how the application of 4C elements in online PBL can help students' communication skills and problem-solving skills for Biology subjects. The study was conducted for three consecutive weeks. The three methods of data collection used at this stage are to interview 6 informants, make observations based on the constructs set in the study on the

six informants and make document analysis on essay marks, project marks (PBL) and learning level (PBD) for the sixth - these six informants. Next, the researcher will make triangulations for all the data collected. The following is the Study Procedure Diagram (Second Stage). In the third stage, the research focuses on theories or findings that have been refined.

The researcher will draw conclusions and determine patterns using cross- case techniques. In addition, the researcher will also focus on the comparison of PBL implementation strategies, theory and then intervene on this theory. The study was conducted for eight consecutive weeks. The three methods of data collection used at this stage are to interview 6 informants, make observations based on the constructs set in the study on the six informants and make document analysis on academic achievement on the SPM test, project marks (PBL) in semester 2 and level learning in classroom assessment (PBD) for these six informants. Next, the researcher will make triangulation for all the data collected. At this stage, teachers will not be involved because the study only focuses on the findings for the implementation of this research. The following is the Study Procedure Diagram (Third Stage).

Data Analysis
Interview Transcripts, Observation Notes for PBL Activities, Comments, Responses and Conversations during Discussions in Telegram Groups and Google Meet

All data sources were analyzed using thematic analysis. Thematic analysis was used to categorize the data and form an appropriate theme to answer the research questions. This analysis begins by analyzing the data, constructing code and then presenting the data in the form of tables, maps or diagrams to facilitate the reader to examine the findings obtained.

For the aspect of communication skills, the researcher focuses on the elements of effective communication as stated by Jaafar Muhammad (Petaling Jaya: Leeds Publication, 2004) and Hisham Al-Thalib (Kuala Lumpur: Nurin Enterprise, 1992). Among the elements focused are communication, influence on attitude, enjoyment and understanding. Whereas according to Abdullah and Ainon (2000), effective communication has five characteristics namely understanding, enjoyment, influence on attitudes, improved relationships, and the presence of follow -up actions. According to Nusaabaum, 2007, these communication skills include the skills of writing, reading, arguing, listening, ethics in communicating, and the use of technology. In the current era of globalization, communication skills have become an essential element that is highly emphasized to be mastered by everyone.

Thinking Skills (HLTS), the researcher focuses on the elements of problem solving as stated by the Ministry of Education Malaysia (MOE), 2013. According to the MOE, HOTS is the ability to apply knowledge, skills, and values in making reasoning and reflection to solve problems, make decisions, innovate, and try to create something. Curriculum Development Division (2013), states that, the concept of assessment is the ability to apply knowledge, skills and values in reasoning and reflection to solve problems, make decisions, innovate and be able to create something. Whereas psychologists state that an individual is learning something when he is trying to solve a problem. This is because in the process of problem solving the individual will seek conclusions, apply problems in daily life, learn the law of problem solving and create some techniques or suggestions for problem solving. This process makes an individual more mature (Anderson 1993).

Classroom Assessment (PBD) and Student Academic Achievement

Classroom Assessment (PBD) and academic achievement are documents analyzed by researchers. Classroom Assessment (PBD) focuses on analysis for the review of notebooks, exercise books and projects produced by students. This review analysis is done in stages based on 3 main domains, namely the domain of knowledge, the domain of scientific investigation and the domain of scientific attitude and pure values. The level of proficiency in students for each component in this excel template is recorded for the purpose of reporting the progress of student learning for a certain period, namely the middle and end of the year. Assessment is done all the time and the level of proficiency in students is monitored on an ongoing basis. This level of proficiency is recorded in a record book, or other place of record and reported twice a year, i.e., in the middle of the year and at the end of the year.

The Classroom Assessment (PBD) assessment rubric for this student has been prepared by the Ministry of Education Malaysia. This matter is stated in the e-book Guide to the Implementation of Classroom Assessment 2nd Edition, 2019 obtained through the official portal of the Ministry of Education Malaysia. This 2nd Edition Classroom Assessment Implementation Guidebook was published by the Ministry of Education Malaysia Curriculum Development Division, in 2019. The following table shows the PBL scoring rubric for students.

Student Academic Achievement

Researchers also obtained information and data related to students' academic achievement in the summative examination and SPM trial examination for the subject of Biology in the form of documents. Among them are analysis of marks for examination questions, analysis of test specification tables and headcount of student results. The defined document is in the form of a written text (Cortazzi, 2002). Silverman (2000) has stated that document analysis is a written storage material such as books, magazines and newspapers. While the analysis of unwritten documents is like video, audio and film recordings. Additionally, Suseela (2001) has stated that document data are available from a variety of sources. Therefore, the researcher will obtain document data related to students 'problem - solving and communication skills through records of students' academic results in the subject of Biology. The record of this document is important to assist researchers in strengthening support for the study conducted later. In addition, the researcher also compared the academic results of students for the Biology subject examination in 2021 through the headcount document in the google drive of a school in Kota Kinabalu. A continuous analysis of the improvement of students for the subject of Biology is made from the results of the summative examination until the trial examination of SPM 2021.

Results and Discussion
1. Analysis of Observations on Respondents' Activities while Implementing PBL Online

Table 2: Analysis of Observations on Respondents' Activities while Implementing PBL Online

Problem Solving Criteria	Identify Problem	Defined Problem	Create Strategy Statistics	Create Strategy	Product Effectiveness
Fara	Yes	Yes	Yes	Yes	Yes
Des	Yes	Yes	Yes	Yes	Yes
Col	Yes	Yes	Yes	Yes	Yes
NG	Yes	Yes	Yes	Yes	Yes
Adam	Yes	Yes	Yes	Yes	Yes
Fun	Yes	Yes	Yes	Yes	Yes

The figure above shows that all respondents were able to identify problems and define problems when implementing PBL online. In addition, they can also make statistics on the implementation strategy of PBL and implement the strategy. Next be able to produce creative and functional work. In addition, they also showed an understanding of the projects they were implementing through the responses given during the online PBP implementation. The six respondents interacted with each other, dialogued, asked about issues

related to daily life and discussed while performing problem-solving processes. Pupils are able to be actively involved in the learning activities they participate in. It is clear here that through exposure to the problem- solving process during learning sessions, students are able to actively engage in the activities in which they participate.

PBL Draft Analysis

Table 3: PBL Draft Analysis

Name	Draft
Fara	Yes
Des	Yes
Col	Yes
NG	Yes
Fun	Yes
Adam	Yes

The figure above shows that all respondents prepared a draft of PBL work before implementing PBL online. As defined in the Malay dictionary, a draft is a writing or drawing prepared roughly at the initial stage or beginning of the implementation of a work. This shows that all respondents make preparations or planning while implementing PBL face to face.

2. Interview Analyse
The following are the statements made by the respondents related to the 3P model. Among the things that drive communication, collaboration, creative and critical skills are the speaking opportunities provided by teachers. In addition, project-based learning is best done in groups as it encourages communication, collaboration, creativity and critical skills among group members. Open and focused questioning techniques are also able to encourage students to collaborate with each other. This in turn encourages students to express opinions, ideas, make connections and explain something based on evidence.

"...what is the factor...that helps you to communicate actively?..." [T1_TC_1]

"... when... given the opportunity to share opinions or ideas, I can go through the results of the information search that I do..." [T1_DS_1]

"... When I am given the opportunity... I will feel appreciated because... it seems, all the information I am looking for, I can share with other friends through the opportunity to give an opinion... hmm, and I feel more confident to do PBL in groups..." [T1_CL_1]

"...I will interact with my group members through direct question and answer... we can work with each other and give each other's opinions..." [T1_FR-1]

"...open-ended questions and answers conducted by teachers, allowing us to express our opinions with each other's explanations..." [T1_AD_1]

"... Okay... for you, through open question and answer... you can give your opinion during PBL...right?..." [T3_TC_1]

"...when the teacher told us to implement a project that was not related to the textbook..." [T3_FR_1]

"...on the other hand, express my opinions and talk more in groups when implementing a new project, especially issues related to daily life...because it's not boring, it even encourages me to interact more actively to get information...hmmm...talk more actively..." [T3_AD_1]

In addition, PBL issues that are not related to the content of the textbook are also able to encourage students to apply the 4C elements in learning sessions. This is because, through issues related to real world problems, they have the opportunity to conduct the research process more closely. They can also understand a biological concept in more detail. This in turn encourages students to innovate through the implementation of PBL. It is clear here that the implementation of PBL is also able to encourage students to apply their imagination and creativity.

"...what are the factors that motivate you to conduct question and answer sessions while implementing PBL?..." [T1_TC_1]

"...hmmmm... I have a lot of question and answer with other group members because this issue is very interesting and not unrelated to textbooks... through this issue, only then did I know apparently the concepts I learned all this time have something to do with my daily life..." [T1_FR_1]

"...for you, right... hmmm... what is the difference between pdp that we have made so far with the implementation of PBL?..." [T2_TC_1]

" tcer...bfore this, I just listened and focused on what the teacher in front of the class said...I just kept quiet and focused...that time, I don't know what I've learned so far has anything to do with with daily life. But, through PBL...I can clearly see the relevance of a concept to my daily life...because I ask a lot of questions and share information with other group members..." [T2_DS_1]

"...PBL provide the opportunity for me to implement the project. So, to find the solution... I ask a lot of questions and share information and experiences with other group members... I get more information... the more I learn from these questions and answers, the more questions arise in my head about this concept..." [T2_FR_1]

"...encourage me to interact more... because sy is a quiet and shy person... when my opinion is disputed, I will try to explain the info more clearly based on the evidence I have so that they can receive the info I am looking for..." [T2_AD_1]

"...how about specific question given during PBL? is that okay?..." [T3_TC_1]

"...focused questions help me to focus more on the investigation I am doing... therefore, I can understand the meaning of a concept in more depth... For example right... the concept of mitosis occurs in plant cloning... through the information search I did, I was excited to

make a serum innovation that uses clove flower extract… because the serum concept uses the concept of cell division…"   [T3_AD_1]

"...questions asked by the teacher while he was monitoring us making PBL in groups helped us to stay on track… we were able to implement PBL effectively because our investigation focused on the results of the teacher's guidance… n were able to eat again…"   [T3_AD_1]

"...what makes you eager to implement PBL?..."
[T3_TC_1]

"... an interesting issue but related to our lives..."   [T1_FD_1]

"... when we discuss a new and life -related issue… at least we know this thing is useful and it works… then we can apply it in our daily routine…"   [T1_FD_2]

"... example kan tcer… in the textbook state about the concept of cell division… so, when we make PBL… we use the issue of making serum… the function of this serum is actually to promote younger cells… when we know plant extracts that can be used in making serum, we can also make our own serum… more eager to make products that can benefit ourselves… "   [T2_CC_1]

"... because if you study to use a textbook… for pbl also use the same kind… kind of good don't bother for a project… better just copy the textbook…"   [T3_AD_1]

"... for sy okay tcer… because kan… focused questions help me to focus more on the investigation that I do… therefore, I can understand bah a concept in more depth..."   [T9_AD_1]

"... I agree with adamlah… unfocused questions will make me focus more in the process of finding information…"   [T9_FD_2]

"... me too tcer… I prefer if PBL uses open -ended but focused questions because I can find out something new in more detail and thoroughly…"   [T9_CC_1]

"... when we were guided… he really helped me and my friends to find information in a focused way than before, I only implement passive learning… so an observer..."   [T10_CC_1]

In addition, the role of the teacher as a facilitator is also able to ensure that the implementation of a learning can be implemented systematically and effectively.

"...tcer time to be a facilitator…tcer can guide us…then we have a guide to make pbl…"   [T11_NG_1]

"... when tcer acts as a facilitator… we can stay on track… we can implement PBL effectively because our investigation focuses on the results of teacher guidance..."   [T11_AD_1]

"... best again tcer just facilitator… because tcer guides us how to solve the problem… instead of… just teach in front… if teaching in front is very boring and passive..."   [T11_FD_1]

"... I prefer the teacher to function as a facilitator rather than the teacher just giving an explanation in front of the class..."   [T11_CC_1]

"...it's very interesting and encourages me to think of more new things that have to do with the biological concepts I'm learning..."   [T13_NG_1]

Even so, during the execution of group work, task specifications need to be implemented. This is important to prevent group members from taking advantage of the abilities of other group members. In addition, it can also prevent the domination of work by certain individuals.

"...so in group work… if there is no task specification… does anyone take advantage?..."   [T2_TC_1]

"…yes... tcer…Even before this, I just sat and waited for other friends to complete group projects, then, some didn't do it right… because I don't feel like there is back up too… so, when the teacher for us the task specifications in detail, I feel more responsible and I know bah… focus of the project that I need to complete in groups…"   [T2_DS_1]

"...hmmm… Teamwork trains us to talk to each other, share information, and make decisions together…"   [T2_FR_2]

Responses from participants showed that they were more motivated to resolve an issue in PBL that was related to real life and not tied to the content of the textbook. Issues that revolve around real life expose students to problem-solving processes. Therefore, students can understand a concept and the relationship of the concept of biology with real life clearly. Students will appreciate knowledge more when they can understand the benefits of that knowledge to them. Therefore, teachers need to be more creative in the selection of issues or problems while using project -based learning methods. This is important to ensure that a biological concept is widely and deeply exposed. If the teacher only relies on the content of the textbook alone, students will feel bored and continue to be passive from engaging in learning activities carried out.

"... high curiosity encourages us to ask more questions, sharing knowledge and experience..."   [T4_DS_2]

"... Example kan tcer… when we share information… I can further develop the idea that I am… through the sharing of knowledge and experience… our discussions are so more detailed… and broad…"   [T5_NG_2]

"... I just listened and focused on what the teacher in front of the class said... I just kept quiet and focused… that time, I didn't know what the function and relevance of the concepts I learned was to my daily life…. I've been

bored for a long time… but when I do PBL online… I do pbl guided… I know what I need to focus on… we can discuss… we collaborate… and I'm excited to create a new product…"   [T6_DS_2]

"…I'm a tcer…Pbl online encourages me to interact more and have a dialogue…because we both discussed compare from before… I just became an observer and just did what was instructed…"   [T6_CC_1]

In addition, online PBL can also facilitate the discussion process among group members. Students are not only able to share information and ideas, but students are more motivated to collaborate in producing quality and functional products. Pupils are able to discuss systematically through question and answer and dialogue sessions among group members. Discussions become more systematic when the discussion is guided by the teacher. Indeed, the role of the teacher as a facilitator is very important to ensure that the discussion that takes place can be conducted in a focused manner through questioning sessions. Student -centered learning provides opportunities for students to build a variety of knowledge and skills.

"…pbl best…but I'm also worried if we do it right…but other members make sambal lewa…then…our marks are affected…"   [T7_DS_1]

"… if the scoring system is done externally… individually and in groups, I feel more confident to implement PBL in groups… because I no longer have to worry about the performance of other group members that will affect my marks…"   [T8_CC_1]

"… Before this, I was willing to offer myself to complete the project on my own even if I did PBL in a group… because I was worried that… hahah… other group members could not do their best and could affect my marks…"   [T8_FD_2]

"…separate marks motivate me and the other group members to be more alert…and we are still diligent in producing the best project…we communicate a lot because we want to produce the best project…"   [T8_DS_2]

One of the aspects that need to be considered when implementing PBL online is the student scoring system. Preferably the scoring system is implemented individually and in groups. This is important to ensure continued commitment from each member of the group. They will continue to collaborate, communicate, discuss, dialogue and exchange views to produce projects that work best. This also encourages students to be actively involved in the learning activities in which they participate. They will be more motivated to implement project -based learning.

3. Document Analysis
Examination Marks

Table 4: Analysis of SPM Trial Examination Marks

Name	Paper 1	Paper 2	SPM Trial Test Results
Fara	35	65	71 (A-)
NG	33	67	72 (A-)
Adam	37	72	78 (A-)
Des	30	54	60 (B)
Col	35	72	76 (A-)
Cel	38	76	81 (A)

Table 5: Comparison of Semester 1 Examination Marks and SPM Test

Name	Semester One Result	SPM Trial Result	Comparison
Fara	44	71	+27
NG	59	72	+13
Adam	51	78	+27
Des	43	60	+17
Cel	60	76	+16
Col	55	81	+26

Based on the figure above, all respondents showed a significant increase in marks in the semester 1 examination and the SPM trial examination. All respondents got A- and A grades, while another respondent got a B grade. This shows that all respondents can achieve the optimum level in the SPM trial semester examination. All respondents have been able to get used to answering questions in the form of easy, medium and KBAT in the SPM trial examination. This is because the percentage of preparation of questions in the form of KBAT for this examination question is 40%, the percentage of preparation of simple questions is 20%, while the percentage of preparation of medium questions is 40%. In addition, all respondents indicated that they have mastered at least 50% in the learning syllabus in semester 2 for the subject of Biology. This is because respondents can understand the content of learning that they learn and there is an improvement in students' problem -solving skills.

Pupils' Learning Levels in Classroom Assessment (PBD) and Project Marks of Semester 2 Respondents

Table 6: Level of Learning (PBD) and Project Marks of Respondents Semester Two

Name	Semester Two Level	PBL Project Mark
Fara	6	92
Ng	5	96
Adam	5	92
Des	5	90
Cel	6	96
Col	5	90

The figure above shows that all respondents were able to achieve levels five and six in classroom assessment (PBD) in semester 2 for the subject of Biology. Respondents who

achieved level five of learning in PBD showed respondents were able to formulate how concepts are used to address a particular problem or issue, formulate the effects of a problem, and always use scientific language to communicate with them. Well and document all sources of information used. While level six shows students who can formulate how concepts are used to address a particular problem or issue, discuss, and analyze concepts to solve a particular problem, use scientific language consistently to communicate clearly and accurately, document information sources and be role models to other students.

Acknowledment

This paper and the research behind it would not have been possible without the exceptional support of my supervisor, DR. Denis Lajium. His enthusiasm, knowledge and exacting attention to detail have been an inspiration and kept my work on track from my first encounter with the draft of 21st Century learning to the final draft of this paper.

My colleagues at University of Malaysia Sabah, Jabatan Pendidikan Negeri Sabah and school community at SM. Lok Yuk Kota Kinabalu, especially the principal of Pn. Lourdes Mary Batin who have also looked over my transcriptions and answered with unfailing patience numerous questions about the research. Pn. Norah Marcus, education officer of the Jabatan Pendidikan Negeri Sabah currently resides, not only provided ideas of the manuscript overnight, but unexpectedly shared the invaluable information on the problem-based learning issues that she has been gathering for almost twenty years.

I am also grateful for the insightful comments offered by the anonymous peer reviewers at Books & Texts. The generosity and expertise of one and all have improved this study in innumerable ways and saved me from many errors; those that inevitably remain are entirely my own responsibility.

Contribution

Ehqa Dhabita and Denis Lajium conceived of the presented idea. Ehqa Dhabita developed the theory and performed the computations. Denis Lajium encouraged Ehqa Dhabita to investigate a 21st Century Learning and supervised the findings of this work. All authors discussed the results and contributed to the final manuscript.

Ehqa Dhabita wrote the manuscript with support from her supervisor, education officers from Jabatan Pendidikan Negeri Sabah and colleagues from Smk Lok Yuk Likas fabricated the research sample. Denis Lajium helped supervise the studies conceived the original idea.

Ehqa Dhabita took the lead in writing the manuscript. All authors provided critical feedback and helped shape the research, analysis and manuscript. Ehqa Dhabita and Denis Lajium designed the model and the computational framework and analysed the data. They carried out the implementation.

Ehqa Dhabita and Denis Lajium wrote the manuscript with input from all authors. They conceived the study and were in charge of overall direction and planning. All authors discussed the results and commented on the manuscript. Ehqa Dhabita and Denis Lajium. Contributed to the design and implementation of the research, to the analysis of the results and to the writing of the manuscript.

Conclusion

In developing balanced and prosperous students who are nurtured with the Six Aspirations of Students, teachers and administrators need to be creative to use the resources available, or that can be obtained through the cooperation of various parties to optimize the teaching and learning process. Pupils who come to school these days are no longer like 'empty barrels' that need to be filled with knowledge. Pupils in the 21st century go to school armed with knowledge gained from various sources from outside the classroom.

It is recommended that students be aware of and use the various forms of support provided by peers, teachers, schools or existing technology available to them. Teachers should also promote a constructivist learning environment by taking into account three main principles namely pedagogical, social and technological aspects. Teachers must ensure that the rules and strategies implemented can be clearly defined. Therefore, to improve the quality of communication, necessary facilities such as better internet connection should be provided, or improved to ensure that online support can be fully utilized by students.

References

1. Hsu JL, Lo SM, Sato BK. Defining Understanding: Perspectives from Biology Instructors & Biology Education Researchers. The American Biology Teacher. 2021; 6.
2. Ismail, Anita, Muda @Ismail, Farah Laili, Sulaiman, Adibah, Mohd Nizah, Mohd Azmir, Abdul Latiff. Pembentukan Pemikiran Kreatif dan Kritis: Hubungannya Dalam Menyelesaikan Masalah. Sains Insani. 2020; 5(1).
3. Mohammad Hazim Amir Nordin. The Culture of Learning Continuum: Promoting Internal Values in Higher Education. Jurnal of Studies in Higher Education, 2020.
4. Norhasyimah Hamzah, Siti Nur Kamariah Rubani, Arihasnida Ariffin, Normah Zakaria, Fazrulhelmi Ahmad. Kaedah Pembelajaran Abad Ke-21 (PAK-21) Secara Atas Talian Dalam Subjek Psikologi Pendidikan. (Buku Kurikulum dan Instruksi Siri 11, Universiti Tun Hussein Onn Malaysia). Bab. Diambil semula dari. 2020; 4:27-36. https://fptv.uthm.edu.my/images/journal_book_chapter/full_book_chapter_Siri_11_lat est.pdf
5. Muhammad Sabri Sahrir, Nurulhuda Osman, Ilyani Syiham Muhammad. Aplikasi 'Konsep 4C' Pembelajaran Abad Ke-21 Dalam Kalangan Guru Pelajar Sarjana Mod Pengajian Pendidikan Bahasa Arab Cuti Sekolah UIAM. e-Jurnal Bahasa dan Linguistik. Diambil semula dari e-Jurnal Bahasa dan Linguistik (e-JBL) (kuis.edu.my), 2020.
6. Sumarni W, Kadarwati S. Ethno-Stem Project-Based Learning: Its Impact to Critical and Creative Thinking Skills. Jurnal Pendidikan IPA Indonesia, 2020, 11-21.
7. Ulfi Indriyani. Upaya Meningkatkan Keterampilan Komunikasi Siswa Dalam Pembelajaran Sejarah Melalui Strategi Giving Question Getting Answer. Jurnal Sejarah dan Pendidikan Sejarah. 2020; 9(1):85-94.

8. Nor Khayati Basir, Mohd Isa Hamzah, Khadijah Abdul Razak. Sikap dalam Pendekatan Pembelajaran Berasaskan Projek Terhadap Pencapaian Pelajar Politeknik di Negeri Perak. Research Gate. Diambil semula dari, 2020. https://www.researchgate.net/publication/345150558_Sikap_dalam_Pendekatan_Pembelajaran_Berasaskan_Projek_Terhadap_Pencapaian_Pelajar_Politeknik_di_ Negeri_Perak

9. Joseph, Suresh Kumar, Alimon, Hashimah, Yusoff, Amri. Learning Biology through Digital Games (DG) in Form Four Classrooms in Malaysia. Journal of Science and Mathematics Education in Southeast Asia. 2019; 42.

10. Wong Weng Siong. Pembelajaran Berasaskan Permainan dalam Pendidikan STEM dan Penguasaan Kemahiran Abad Ke-21. Politeknik & Kolej Komuniti Journal of Social Sciences and Humanities. 2018; 3.

11. Nargis, Armelia, Lisa. Optimizing EFL learners' communicative competence through short movie project. Asian EFL Journal. 2018; 20(5).

12. Nindiya Eka Safitri. Meningkatkan Teamwork Skills Melalui Layanan Bimbingan Klasikal Berbasis Cooperative Learning. Tajdidukas. 2018; 8(1).

13. Kamisah, Osman, Siti Mariam, Zazam. Pengetahuan dan kemahiran guru Sains sekolah rendah terhadap pemupukan Kemahiran Berfikir Aras Tinggi (Kbat) dalam pembelajaran. Research Gate, 2017.

14. Halim, Mohamad Nizam Arshad dan Abdul. Menjana kemahiran berfikir aras, tinggi (KBAT) dalam penyelesaian masalah matematik tambahan. Universiti Teknologi Malaysia, 2017.

15. Akhtar H, Abdul Ghani Azmi I. Komunikasi kepimpinan berkesan. Jurnal syariah. 2017; 25(3).

16. Amir, Aris, Ahmad Rozelan, Yunus. Komunikasi Berkesan. Research Gate, 2016.

17. Fazilah Binti Razali, Othman Bin Talib, Azraai Bin Othman. Aplikasi Kemahiran Proses Sains Dalam Pembelajaran Berasaskan Masalah Untuk Mata Pelajaran Biologi. Jurnal kurikulum & Pengajaran Asia Pasifik. 2016; 4(3).

18. Maimunah Binti Nasir. Pembelajaran Berasaskan Masalah Dan Amalan Pembelajaran Arah Kendiri Ke Arah Perubahan Kefahaman Murid Tingkatan Enam Dalam Konsep Genetik. (Tesis Doktor Falsafah, Universiti Sains Malaysia), 2016. Diambil semula dari http://eprints.usm.my/31557/1/MAIMUNAH_BINTI_NASIR_24.pdf

19. Nor Ezah Binti Ariffin, Nurulwahida Binti Hj. Azid @ Aziz. Persepsi Murid Tahun Lima Terhadap Penggunaan Kaedah Model Bar Dalam Penyelesaian Masalah Matematik Berayat Tajuk pecahan. International Seminar on Generating Knowledge through Research. 2016; 1:287-304.

20. Sumarni W. The Strenghths and Weaknesess of the Implementation of Project Based Learning: A Review. International Journal of Science and Research (IJSR). 2015; 4(3).

21. Aziza Kavlu. Implementation of Project-Based Learning (PBL) in EFL (English as a Foreign Language) classrooms in Fezalar Educational Institutions (Iraq). 5th International Research Conference on Education, 2015. ISSN 2298-0180.

22. Fazliza Binti Che Mat. Kesan Pengajaran Dialogik Terhadap Kemahiran Menaakul Saintifik, Kemahiran Berhujah dan Pencapaian Sains Dalam Kalangan Murid Sekolah Rendah. (Tesis Doktor Falsafah, Universiti Sains Malaysia). Diambil semula dari, 2015. http://eprints.usm.my/31391/1/FAZLIZA.pdf

23. KPM. Kemahiran Berfikir Aras Tinggi (KBAT) dan Perlaksanaan KBAT di Sekolah, Buletin Anjakan, 2015.

24. Zakaria, Suhaimi, Othman, Aris, Baharuddin, Mohammed. Penerapan kemahiran berfikir aras tinggi melalui model stesen rotasi pelbagai mod. Konvensyen Antarabangsa Jiwa Pendidik, 2014

25. Mohd Azli Yeop. Kesan Pendekatan Pembelajaran Berasaskan Pzzrojek Berteraskan, Jurnal Pendidikan Bitara UPSI, 2013.

26. Brown C, Texas A. The implementation of project-based learning. National Forum of Educational Administration & Supervision Journal. 2012; 30(1):26-26.

27. Rian Vebrianto, Kamisah Osman. Keberkesanan Penggunaan Pelbagai Media Pengajaran dalam Meningkatkan Kemahiran Proses Sains dalam Kalangan Pelajar. Jurnal Pendidikan Malaysia. 2012; 37(1):1-11.

28. Hafiza Binti MD Nasir. Keberkesanan Pembelejaran Aktif Terhadap Pencapaian Pelajar Perempuan Dalam Biologi. Fakulti Pendidikan Teknik dan Vokasional, 2012.

29. Halizah Binti Awang. Kesan Pembelajaran Berasaskan Masalah Terhadap Penguasaan Kemahiran Generik Dan Pencapaian Akademik Pelajar Di Politeknik Malaysia. Tesis Doktor Falsafah, 2010.

30. Khairulhelmi Katip, Bazitah Abu Bakar, Florence Fletcher Malia. Tinjauan Perlaksanaan Pembelajaran Berkumpulan Di Kalangan Pelajar Institusi Pengajian Tinggi Swasta (IPTS) Di Johor Bahru. Jurnal Pendidikan. 2005; 10:1-7.S