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# Problem Solving in an Online Project Based Learning for Biology Subject

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## **Abstract**

Problem solving is the way by which solutions are developed to remove an obstacle from achieving an ultimate goal. However, students' 21st century skill-focused problem-solving skills are more than just the ability to solve specific problems. Successful problem solving requires a person to be able to express opinions, argue based on evidence and be able to apply biological knowledge to real-life problems. This requires the activation of a project-based learning strategy through the application of the 4C elements, namely communication, collaboration, critical thinking and creativity. An analytical study to identify problems through observation, document analysis and interviews was conducted on 7 students involved in Project Based Learning. The objective of the second level study is to test the initial theory by using the ISP Model through the method of observation, interview and document analysis. The objective of the third level study is to refine the findings or theories implemented through interviews, observations and document analysis. This study is a Qualitative Case Study to understand more deeply about the application of 4C' elements in online Project Based Learning to help students' problem solving skills for the subject of Biology. All data obtained through interviews, observations and document analysis were analyzed using the Triangulation technique. This finding concludes that there is a need to apply 4C' elements in online Project-Based Learning for Biology Subjects. This concept paper provides a framework that enables the construction of strategies and meaning that will be done through modelling, guidance and strategy application of 4C elements in project-based learning. 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 gain knowledge through projects, cooperative learning and 'hands on' techniques. Through project implementation, students can build knowledge and skills through the inquiry process. The integration of project-based learning may encourage students who are unable to solve a problem by learning the strategies proposed in the phase that has been set.

**Keywords :** *4C's Elements, Biology, Inquiry, Project- Based Learning, Problem Solving, Strategy, Skills, Inquiry*

## **I. INTRODUCTION**

In the age of science and technology, without sufficient scientific knowledge, it is difficult for Malaysians to move forward. Subahan (1997) thinks that Malaysians should be science literate so that they have knowledge and know how to use science and technology information sources. However, most of today's students consider the subject of science to be a difficult and burdensome subject, especially for the subjects of Biology, Physics and Chemistry. They consider the concept of learning in the subject of Biology to be a difficult concept to understand. Concept is an important element to thinking skills (Johari 1995). The achievement of learning

show students' level of conceptual understanding objectives, one of which can be measured by students' cognitive learning results (Anderson & Krathwohl, 2001). Cognitive Learning Outcomes

(Anderson & Krathwohl, 2001; Sinatra & Mason, 2013). Conceptual understanding is a learning outcome that consists of remembering, understanding, applying, analysing, evaluating, and creating (Anderson & Krathwohl, 2001). Students' cognitive skills are the basis of students' needs in dealing with challenges in everyday life (Osborne, 2013; Wang, Wu, Kinshuk, Chen, & Spector, 2013). Jantz (1998) stated that assessment in education is not just to ensure the correct answer, but focuses on the quality of teaching and thinking related to the concept. From this statement it is clear that thinking skills are important for problem solving in Biology education and they can be fully mastered through the use of the right learning approach.

PBL uses a dynamic approach so that problems and challenges in the real world can be explored by students. (Gultekin 2005; 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).

physics and biology is more to the understanding of the mechanisms and processes of science supported through experiments, and inventions. All 21st

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.

Critical thinking skills and effective communication skills are essential skills in leading and facing rapid developments in science and technology. There are many challenges facing educators in this day and age. Among them is the challenge to guide students to always think creatively and critically. Biology is a subject that not only focuses on the memorisation of concepts alone, but also involves the understanding of sciences such as chemistry,

century skills such as collaboration skills, critical thinking skills, creative and effective communication skills can be nurtured through activities such as problem solving and design innovation projects. The Malaysia Education Blueprint 2013-2025 considers activities based on creativity and innovation as important, where all these activities can encourage students to always think about new solutions and create opportunities for their careers (Ministry of Education Malaysia, 2017). Therefore, PPPM 2013-2025 has placed emphasis on developing creative and innovative human capital to meet the needs of the country in the 21st century. 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 higher order thinking skills 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 higher order thinking skills for Biology subjects online.

and problem solving skills and evaluation of the implementation of PBL online. The procedure for this study is categorized into three levels.

## II. LITERATURE REVIEW

### Pupils' Problem Solving Skills While Implementing Project Based Learning (PBL) For Biology Subjects

Biology learning can be used to develop students' high-level thinking skills such as critical thinking. Critical thinking is a complex thought process consisting of interpretation, analysis, conclusion, evaluation, explanation and self-organization (Facione, 2011). Critical thinking is referred to as high-level thinking that encompasses the top three abilities in Bloom's Taxonomy namely the ability to analyse, synthesize, and evaluate (Bookhart, 2010; Moore & Stanley, 2010). The development of critical thinking skills can be done with open-ended questions or different questions. Open-ended questions are questions that expect many possible correct answers (Subali, 2013). Nevertheless, there are studies that state that Biology subjects do not challenge the mind because the focus of learning is more in the form of memorization (B. Barron, 2000). The report of the Planning and Research Division found that overall students only used memorization techniques in the subject of Biology and as a result students did not answer questions in the form of problem solving (Ministry of Education Malaysia, 2010). Therefore, it is not surprising that students are not able to answer questions in the form of analysis and correlation. This is because learning by "deep learning" does not occur among students during the learning session because learning occurs passively

## III. RESEARCH METHODOLOGY

This study was conducted based on research questions; How can the application of 4C elements in online Project-Based Learning help students' communication skills and problem-solving 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 is only teacher-centered. This is even more worrying if this traditional learning continues to happen during the online learning that is happening nowadays. If this situation persists, then students' problem-solving skills cannot develop because passive learning cannot help the development of students' critical and creative skills. Pupils will continue to be listeners to the information presented by the teacher while the teacher acts as an informant. One of the learning models that develops students' critical and creative thinking skills for the subject of Biology is project-based learning. PBL not only provides students with knowledge but also enhances their problem-solving skills, critical and creative skills, future learning, communication skills, teamwork, adaptation to change, and self-assessment (Khoiri et al., 2013). In PBL, real world problems are used to push students through the problem (Farhan & Retnawati, 2014). During the problem solving process, there will be an exchange of information between students and other students so that the problem can be resolved.

The process of teaching and learning Science requires innovative and creative approaches, methods and techniques of student centered teaching and learning and active learning among students. Creativity development aims to provide students with a variety of skills and knowledge to face the challenges of the world of work (Kind & Kind, 2007). In fact, the development of students' creativity in school has not yet reached the optimum level. This is because, the lack of attention to the development of creativity is due to the notion that creativity cannot be learned and measured. Trilling & Fadel (2009) state that creativity can be learned through a learning environment that supports questions, patience, openness to new ideas, high trust and learning from mistakes and failures. Creativity can be developed with constant practice

A case study is a research design that is suitable to be used if the research process is about the process (Meriam 2001) because it can provide an overview or pattern to understand the process. To explain the importance of researching the process in case studies, Sander (1981) explained that case studies help us understand the processes involved in an event, project and program and explore the characteristics of the context that will shed light on an issue or object. Robert Yin, in his book *Case Study Research: Design and methods*, defines a case study as "an empirical inquiry that investigates a contemporary phenomenon within

its real-life context; when the boundaries between phenomenon and context are not clearly evident; and in which multiple sources of evidence are used" (Yin, 1994,

p.s,23). The case study focuses on a group of students from the same school. The researcher chose a case study to carry out this research based on four specific reasons. First, it provides a context that fits the research question for this research. Second, the researcher is interested in the findings and interpretations in the study rather than hypothesis testing. Third, it helps the researcher to examine the extent to which the results support the existing theoretical framework and research work. Fourth, it uses qualitative data collection methods and triangulation to achieve a thorough understanding of the case investigation.

For this study, the researcher conducted a qualitative case study on student project-based learning online. The case study is also a project to help improve communication skills and problem-solving skills through the application of 4C' elements in project-based learning for Biology subjects. The case study design implemented in this study can be further defined based on its characteristics, disciplinary orientation and topology. These three aspects of case study design provide information about the focus, the object of inquiry and the results of the case study.

### **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 Student Team Achievement Divisions learning Model. Next, students will be exposed to the learning objectives for the field of learning as the steps recommended in the ASSURE (Analyse learners, state objectives, select methods, utilize media, require learner participation, evaluate and revise) 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 and problem-solving method. 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 use questions created using the questioning and problem-solving method

conclusions and determine patterns using the cross case technique. In addition, the researcher will also focus on the comparison of the PBL implementation strategy, theory and then perform interventions on this theory. The study was conducted for eight consecutive

### **Study Procedures**

The first stage is carried out to identify the problem, the second stage focuses on research questions or preliminary theories that are tested and the third stage focuses on theories or findings that have been refined. In the first stage, the researcher conducted a study to identify the problems faced by students in terms of communication skills and online problem solving skills for the subject of Biology. The three data collection methods used at this stage are interviewing 7 informants, making observations based on the constructs set in the study of the seven informants and analysing documents about academic achievements in semester 1, project marks (PBL) in semester 1 and evaluation learning level (PBD) in semester 1 for these seven informants. Next, the researcher will triangulate all the data collected. This research was conducted for 8 consecutive weeks.

In the second stage, the research focuses on the research questions or preliminary theories that are tested. The researcher conducted a study at this stage to see how the application of 4C' elements in PBL online can help students' communication skills and problem-solving skills for Biology subjects. This study was conducted for three consecutive weeks. The three data collection methods used at this stage are interviewing 7 informants, making observations based on the constructs set in the study on the seven informants and making document analysis about the essay marks, project marks (PBL) and learning level (PBD) for the seven informants. Next, the researcher will triangulate all the data collected.

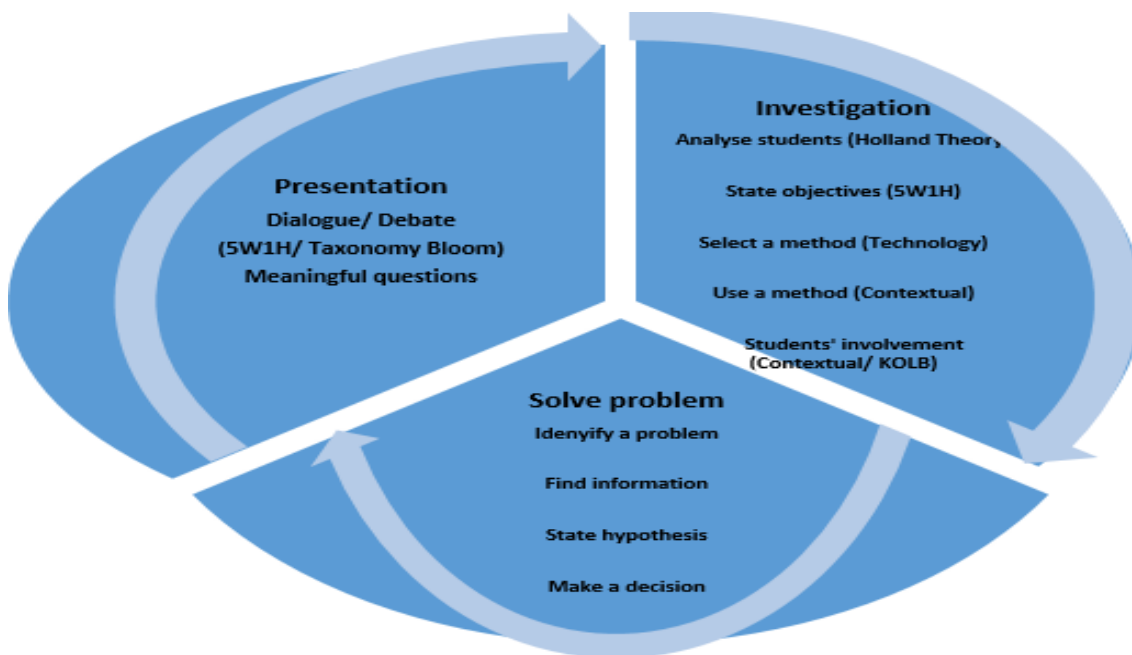
In the third stage, research focuses on theories or findings that have been refined. The researcher will draw



weeks. The three data collection methods used at this stage are interviewing 7 informants, making observations based on the constructs set in the study of the six informants and analysing documents about academic achievement in the SPM attempt,

project marks (PBL) in semester 2 and level learning in classroom assessment (PBD) for these seven informants. Next, the researcher will triangulate all the data collected.

**Online PBL Model**



**IV. RESULT AND DISCUSSION**

**Interview transcripts, observation notes for PBL activities, comments, responses and conversations during discussions in telegram groups and google meet.**

All data sources were analysed 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 analysing 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.

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, Higher order thinking skill 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.

### **Classroom Assessment (PBD) and Student Academic Achievement**

Classroom Assessment (PBD) and academic achievement are documents analysed 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, in the middle of the year and at the end of the year.

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,

**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. In addition, 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**

Problem Solving Criteria	Identify Problem	Defined Problem	Create Strategy	Create Strategy	Product Effectiveness
Para	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

they also showed an understanding of the projects they were implementing through the responses given during the online PBL implementation. The seven 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.

students to achieve goals and consensus in the group. Next, the third phase, students will

### **PBL Draft Analysis**

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

In this study, students are expected to conduct project-based learning that applies 4C' elements during its implementation online. Students will carry out 3 phases of PBL. In the first phase, students are divided into several groups. Each group consists of students who have differences in terms of abilities, tendencies, knowledge and experience of existing students as stated in the Student Team Achievement Divisions learning model. Next, students will be exposed to the learning objectives for the learning area as recommended in the ASSURE model. Students will also be exposed to issues related to the field of learning. After that, the teacher will act as a facilitator and question the students using a set of meaningful questions made based on reference to the learning objectives and the questioning and problem-solving method. Students are guided to discuss and encouraged to prepare a mind map during the discussion.

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

present their products. Students are encouraged to prepare a mind map. Students will be guided to dialogue and argue about the advantages, disadvantages and improvements of the products they produce. The presentation session was conducted using a set of questions made using the questioning and problem-solving method.

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.

### Interview Analyse

The following are the statements made by the respondents related to the ISP 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

“... 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]

information search that I do...”

[T1\_DS\_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]

“... 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]

“ teacher ... before 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 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..."

[T11\_CC\_1]

[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]

"...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... are able to eat again..."

"... 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]

"... 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 ..."

"... 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..."

[T11\_AD\_1]

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

[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 teacher... 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 teacher... 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]

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.

## Document Analysis

### Examination Marks

#### 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)

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 higher order thinking skills in the SPM trial examination. This is because the percentage of preparation of questions in the form of higher order thinking skills 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.

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

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

**V. CONCLUSION**

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.

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

Project-based learning allows students the opportunity to apply knowledge, improve skills and stimulate students' minds to be more creative and critical. This is important to ensure students can think and be able to solve whatever problem is given. Pupils who are exposed to a problem-solving approach communicate more easily and have the courage to communicate whether with teachers, peers or with other individuals. Students who want to find information need to be good at communicating to get the necessary information. Pupils will be more confident and brave to present their work when they know how to communicate. Students who have problem solving skills will always think. This is because they use commonsense to generate ideas. In addition, they are more independent and diligent than students who do not have problem solving skills. The problem solving process begins with the problem identification phase. Next, the search and collection of information related to the given problem. After that, students will start making hypotheses or making predictions. The hypothesis made needs to be tested by students. In the final phase, students make an assessment and then make a conclusion based on the problem that has been solved.

The teacher's role now is as a guide who can make students aware that the process of learning and acquiring knowledge happens anywhere regardless

of the time throughout their lives. The effort to guide these students requires a creative way, not only the knowledge shared by the teacher through the requirements set in the standard curriculum but also

the sharing from the students through the knowledge gained outside the classroom through various mediums. Teachers need to cultivate Higher Level Thinking Skills (HOTS) among students through questioning methods that are appropriate for the students' level. Students need to communicate, share creative ideas and learn collaboratively inside and outside the classroom. No matter preschool students, special education students or Sixth Form students, every student can be nurtured by KBAT with the questioning strategy as was revealed to every teacher when they went through teacher training a while ago.

In order to achieve the goals of an organization, everyone involved needs to work together to ensure the effectiveness of an implementation. Strong work from one party alone is not enough to ensure that the implementation runs systematically. Everyone involved needs to be aware of their respective responsibilities and carry out the assigned tasks dynamically. Therefore, successful implementation can be achieved. Everyone involved needs to be aware of their respective responsibilities. This is because the main purpose of the education system in our country is to produce human capital that is balanced in terms of physical, spiritual, intellectual and emotional. These students are our hope to lead the country in the future. Together we join hands in ensuring success in this implementation.

#### **ACKNOWLEDGMENT**

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.

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.

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