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The challenges of implementing project-based learning in Physics

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Abstract. The purpose of this research is to identify the challenges in implementing project-based learning (PBL) in physics among physics teachers in Johor, Malaysia. The qualitative research methods were employed using the case study design. The data were analysed using ATLAS.ti application and were carried out for five teachers. The key result indicates the five main challenges of implementing PBL that the teachers faced, which are management commitment, sources, students' readiness, students' time, and teachers' time. Based on the analysis of data with ATLAS.ti, how the challenges are connected to one another based on the quotes that each teacher wrote represent. PBL has numerous benefits for both teachers and students, but it also provide challenges that they had to deal with. The challenges identified will help other physics teachers if they are to implement PBL in their lessons, especially in making PBL successful. For further recommendation, other aspects of project-based learning, especially the concepts of PBL among physics teachers, may be studied. Method

1. Introduction

Variety of teaching and learning methods to give students the knowledge and skills necessary for the Fourth Industrial Revolution [1]. One of them is project-based learning (PBL). Because PBL focuses a balanced emphasis on the creation-related aspects of students' thinking and behaviour, it differs from typical teaching and learning techniques that emphasise drill-and-practice. Note that level six (TP6) is the greatest degree of mastery for the "creating" level on the classroom assessment in Malaysian schools [1]. This suggests that in order for students to reach the highest level, TP6, they must be able to create a novel idea or product.

In the context of this study, PBL is defined as student-centred learning with group work as one of its key components. Project-based learning is a collaborative teaching technique focused on inquiry in which students work in groups to integrate, apply, and build knowledge to solve difficult problems [2].

The characteristics of PBL that have been identified from past studies [3-6] suggesting that there is a need for starter questions to trigger students' thinking to begin their projects, while the objectives and direction of the project also need to be emphasized before starting the project. Each project requires cooperation among group members to ensure the effectiveness of the project, and scientific elements



need to be applied during carry out the project. Finally, there should be tangible outcomes of the project such as products or reports.

Although PBL is seen to provide many advantages to both students and teachers, in practise, there are also challenges faced by teachers when implementing PBL. One of the challenges that exists is that PBL requires versatile teachers and adds to the teacher's workload because their role is very important in making a project successful [7]. PBL needs teachers who are prepared enough with planning so that teaching and learning can run smoothly. PBL also requires teachers who are committed throughout the PBL process. This requires the sacrifice of a lot of time and energy, and teachers need to be physically and mentally prepared. This statement is also supported by [8] who found self-attitude, time, the need for tools and materials, as well as expenses, to be obstacles and challenges during the implementation of PBL.

Based on the problems stated above, this study will focus on the PBL design used by Physics teachers who practise the PBL method. In addition, specific features involving a physics teacher's PBL practise will also be given focus in this study since design is usually more general, so there must be specific features that display more specific elements in the design involved. Next, an in-depth explanation will be produced to understand how and why Physics teachers practise the PBL method as they often do. This can be done by producing a framework that can explain the PBL practises of the Physics teachers involved.

This study's objective is to identify the challenges faced by the physics teachers in Johor, Malaysia when implementing PBL. This objective is pivotal because many studies on PBL were often conducted in the context of university or higher education, while studies in the school context are still lacking at large

2. Method

In this study, qualitative research is employed. Five physics teachers that implemented PBL in their classrooms participated in interviews as part of the case study design, which was utilised to collect data. After that, a transcription of each interview was produced. The ATLAS.ti tool was then used to analyse the transcriptions. The data was analysed to determine the challenges that the physics teachers faced when implementing PBL. Several codes were developed to analyse the data and to get the keywords from the analysis. Each participant was quoted to start the analysis step. After that, a diagram was developed to show the connections between the challenges the physics teachers faced.

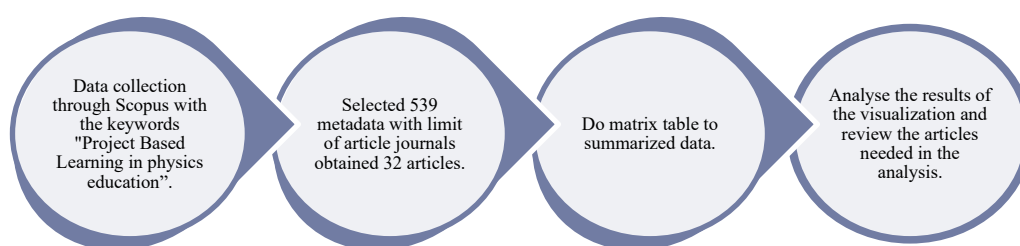


Figure 1. Data collection and processing methods.

Data analysis was done using ATLAS.ti 9.1.7. The codes were developed in response to the types of challenges in implementing PBL among the physics teachers. The codes are as follows.

Table 1. Description of codes

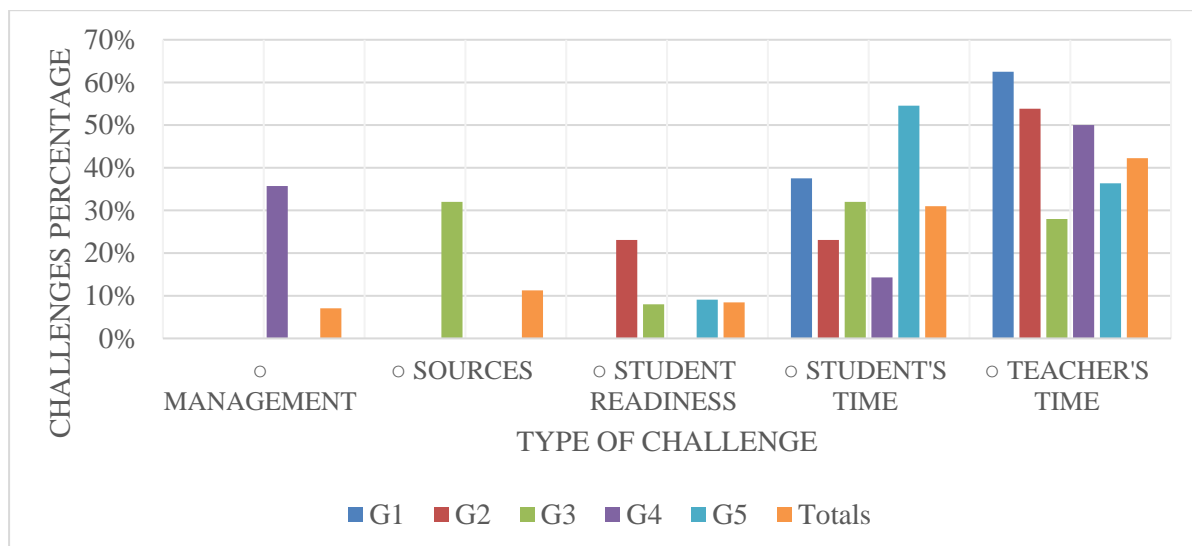
CODES	DESCRIPTION
G1	First Physics teacher
G2	Second Physics teacher
G3	Third Physics teacher
G4	Fourth Physics teacher
G5	Fifth Physics teacher

Table 2. Description type of challenge

CODE	TYPE OF CHALLENGES	DESCRIPTION
1	Time for teacher	How teacher manage their time to handle their classes.
2	Time for student	Time allotted for students to finish their projects, from start to finish
3	Student readiness	Student preparation before and during the project including researching information from books, the internet, or the teacher
4	Source	Project sources include a computer, the internet, and cameras.
5	Management commitment	The teacher may be involved in school management, such as completing the syllabus, tracking key performance indicators, or setting the overall educational goals.

3. Result and Discussion

The challenges that the five physics teachers encountered while implementing PBL in their classroom are depicted in the bar graph below. The top five difficulties were identified. Specifically, these include management commitment, resources, student preparation, students' time, and teachers' time. Time for teacher is the biggest challenge the five physics teachers encountered, while students' time is the second challenge that is strong for many physics teachers. On the other hand, management commitment and sources are two challenges that were uncommon for many teachers.

**Figure 2.** Challenge percentage of five Physics teacher faces

The top five challenges were counted. They consist of management commitment, sources, students' readiness, students' time, and teachers' time. The time of the physics teacher covers 42% out of 100%, while only 7% covers for the management commitment.

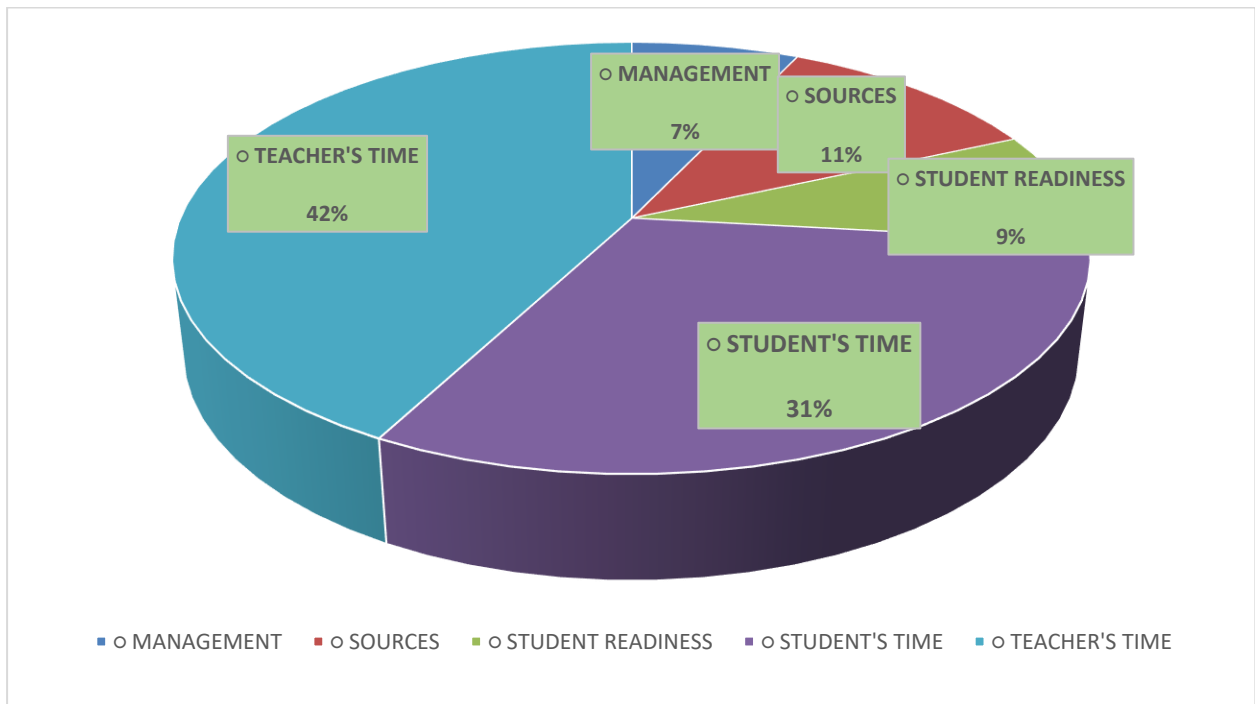


Figure 3. Percentage types of challenges that teacher faces

The figure 4 illustrates how the challenges are connected to one another based on the quotes that each teacher wrote. The diagram was built with ATLAS.ti application to analyse all the data.

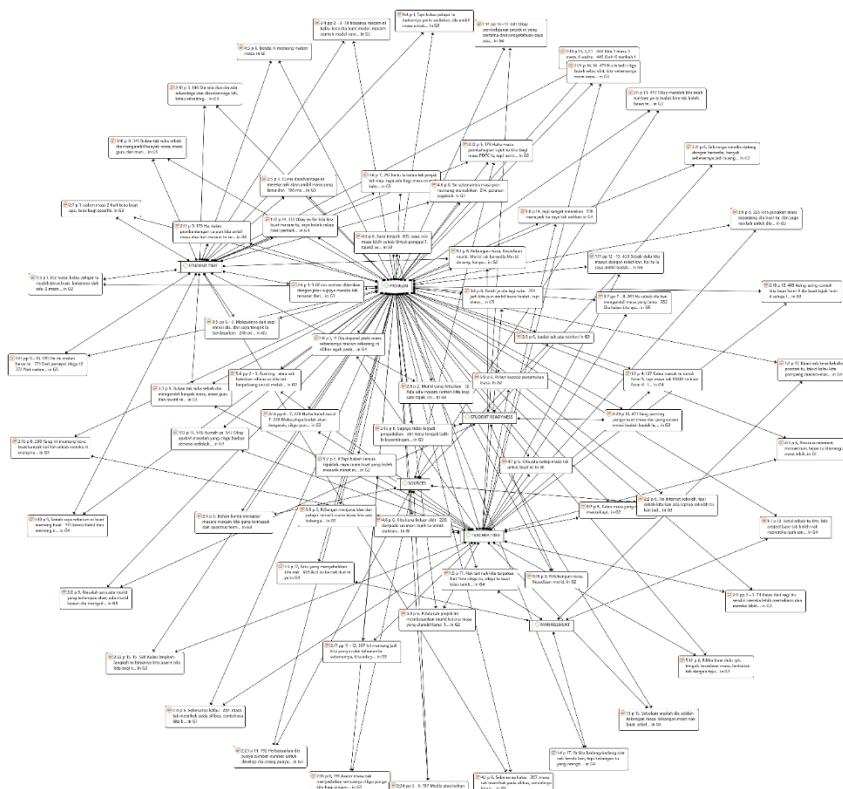


Figure 4. Quotation related to each type of challenges (for high quality image: <http://bit.ly/46pdko8>)

Based on the analysis of data, PBL has numerous benefits for both teachers and students, but it also provide challenges that they had to deal with. Each kind of challenges will need to be encountered as PBL is put into practice. Every challenge may have a specific solution. According to scholars, the teachers must be strategic in their planning due to time constraints [6]. Because project-based learning takes a while to complete, [9], the physics teachers should create a timetable or schedule from beginning to completion. As a result, the teachers must prepare to complete the syllabus on a time-by-time basis. Due to time constraints, students must divide tasks intelligently with the help of physics teachers. In order to successfully perform the work, the teacher or student must take the initiative to locate the appropriate sources,[10] and either borrow them from someone else or purchase them on their own. In order to meet the challenge of student preparation, the student must also have the initiative to use the internet, books, or teacher resources to locate the information they need to do their assignment. They won't receive high scores for their project if they don't have enough knowledge or preparation about the equipment. Regarding the management challenge, the teacher must be savvy to handle any issue between the administration of the school and the student. They will have a bigger problem with their profession if they are unable to overcome the obstacles.

In order to successfully perform the PBL, the teachers or students must take the initiative to locate the appropriate sources [10] and either borrow them from someone else or purchase them on their own. In order to solve the challenge on students' preparation, the students should also have the initiative to use the internet [13], books, or teacher resources to locate the information they need to do their tasks. They may not be able to get good results for their project if they do not have sufficient knowledge or preparations. Regarding the management commitment, the teachers should be wise to handle any issues between the administration of the school and the students, probably by making discussion among the parties to solve the issues [12].

Before beginning the PBL as the teaching method, physics teachers need to properly evaluate how to overcome these challenges and make systematic plans. This measure may help them implement PBL with readiness and having alternative plans when facing the challenges. Having clear plans may not always be common among physics teachers probably because they are not well trained to implement PBL in actual settings in classrooms. Physics teachers will need to be given sufficient training for implementation of PBL [13].

PBL adds to the teachers' workload [14] because their role is very important in the success of a project [8]. In order to carry out successful PBL, physics teachers need to be sufficiently prepared with clear planning [15] so that teaching and learning run smoothly. Physics teachers need to be committed [16] throughout the implementation of PBL. It may require the sacrifice of a lot of time [11] and energy, thus physics teachers need to be physically and mentally prepared. This advice is also supported by [15] who found self-attitude, time, the need for tools and materials, as well as expenses to be obstacles and challenges during the implementation of project-based learning, as the factors that need to be taken into account when implementing PBL, including in physics.

In terms of originality, this study has originality because it is rarely conducted in depth with a qualitative approach, especially the case study method. This feature of originality is important as a way to ensure that this study does not overlap or repeat with any previous studies, especially in Malaysia.

4. Conclusion

The physics teacher encountered five challenges while implementing PBL in the classrooms, even though PBL offers many benefits. The challenges were teachers' time, students' time, students' readiness, sources, and management commitment. Before implementing PBL, physics teachers must have a clear plan in place to address the five challenges. Moreover, physics teachers need to be skilful in managing their teaching. For future research, other aspects of PBL may be carried out, especially the concepts of PBL among physics teachers.

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