

Indicating Classroom Observation Protocols in PBL Studies

Wenjia Li^{1,*}

¹ Faculty of Education, The University of Hong Kong, Hong Kong, 999077, People's Republic of China

Abstract. This paper investigates whether the classroom observation protocol can be adopted in PBL studies, to explore the appropriate instruments for further observation-based studies in PBL obtain. By systematically searching and concluding previous literature, the observation protocols are given special focus, leading to the main results of this review: 1) There is one formal observation tool developed for PBL settings in the area of STEM (science, technology, engineering and mathematics) education; 2) Apart from the only PBL-aimed protocol, there are other studies using tools specially designed to demonstrate teachers' behavior and students' engagement in real school settings; 3) Classroom observation could offer practical evidence for further exploration in a study using a mixed methodology, but formal observation tools should be adopted in these studies. In PBL studies, classroom observation could be an innovative method for further research, and more observation protocols are encouraged to be adopted or developed in the PBL obtain.

1 Introduction

PBL, an abbreviation of problem-based learning, has been widely implemented as an innovative pedagogical improvement for the past several decades, with many scholars conducting PBL programs in their study fields [1-5]. This educational method was first developed in the medical school program of McMaster University, which focused on the small-group tutorial during healthcare scenarios and has been applied in various healthcare professional schools [6]. Although numerous studies on PBL have been conducted in various educational fields, few studies have used classroom observation as part of the research methodology. This article demonstrates the possibilities of collecting possible classroom observation instruments appropriately implemented in PBL research, which is based on data generated from classroom observation and systematically enumerates the observation protocols in the studies through a review of the literature. This article attempts to seek specific observation instruments designed for PBL settings, to induct and reorganize the practicable protocols which can be used for observing PBL classrooms, and to define the role that classroom observation may play in the whole methodology of PBL studies.

2 Observation Instrument for PBL Programmes and Related Research

During the past decades of PBL studies, there was one special observation instrument developed for teachers' PBL classroom instruction [7]. As one of the most related classroom observation protocols, the observation instrument is applied specifically for the STEM PBL activities at the secondary stage of education.

In general, the observation instrument arose from a focus on teacher feedback, which is always expected to result in significant improvements in the quality of STEM courses. Thus, teachers' instructional behaviors may have an impact on students' academic outcomes [8], and appropriate instruments for constructive evaluation must be designed. The instrument discussed by Stearns is a five-point scale which is the most suitable to evaluate teaching and learning objectives that are observable when PBL activities are carried out and further developed by teachers. And according to the statement of this literature, it had already been taught to both observers and teachers by a sustained professional development for three years with ten full days every year, totally counting for 30 full days and more than 240 contact hours. As for the structure, the instrument includes 6 objectives and 22 items. These included six objectives: (a) Structure of PBL, (b) Facilitation of PBL, (c) Students' Participation, (d) Resources, (e) Assessment, and (f) Learning Environment in Classrooms. Besides, indicators under each objective varied from subjective to subjective. And since it is a five-point based scale, each indicator was scored from 1 (no evidence) to 5 (to a large extent), with the observer assigning a score to each item based on the evaluation.

After the observation instrument for PBL was developed, several studies related to PBL programs have already adopted it as the main research tool. Capraro et al. carried out a 3-year study on sustained professional development planned for 3 distinct schools in an urban area, demonstrating a keen interest in the effects of sustained professional development in STEM settings [9]. Since this 3-year study applied a mixed methodology including both quantitative and qualitative research, the observation protocol designed by Stearns et al. was mainly used for data collection of the quantitative research part [7]. In order to align with the next three years, data were gathered while

*Corresponding author E-mail: u3596554@connect.hku.hk

teachers were undergoing professional development for the year prior to the start of the PBL project. The research personnel who worked on the classroom observation were well-trained prior to the observation, and the interrater reliability was calculated using mixed pairs designed by James, Demaree, and Wolf [10]. After the data analysis of quantitative research, observation instrument results indicated that there was a significant improvement in mean scores for each category of a total of six compared with the previous observation records in the year before the study. The longitudinal observation resulted in the phenomenon that means observational patterns could emerge within schools disaggregated by level of implementation. Furthermore, children who had the highest levels of implementation fidelity generally demonstrated advances on standardized test scores, whereas students who experienced the lowest levels of implementation fidelity showed losses.

Overall, Stearns' classroom observation tool focuses more on teachers' qualifications for instructional management during PBL programs, which is reflected in the emphasis on the professional development of PBL tutors. Thus, the instrument also emphasizes students' academic performances and the project products after the PBL process, which represents the logic of summative assessment.

3 Research Adopting Observation Tools Focusing on Teacher Behaviors and Student Engagement

Different from the literature developed from data collected by interviews, more attention has been paid to teachers' guidance behaviors and student engagement in research using the classroom observation method [1][5]. As a result, some classroom observation tools used in PBL studies would also place a greater emphasis on teachers' behaviors and students' engagement in the real schooling environment.

For the increasing emphasis on documenting student engagement in medical schools caused by teaching strategy changes, by adding student interaction in medical education settings, O'Malley and Moran established an observational tool called STROBE to gather more promising data for educational research and evaluation [11]. This tool comprises continuous 5-minute observing cycles that are repeated throughout the instructional period. Observers are needed to use an interval recording technique during each cycle, focusing on particular characteristics of behavior that happen in each interval. Generally, STROBE often expects to capture behaviors for a time period that yields a representative sample of the setting's interesting behaviors.

Kelly et al. used seven qualified observers to measure learner engagement in seven lecture, four problem-based learning, and three team learning classrooms over the course of a year in order to compare students' participation across classes using the lecture, PBL, and team learning models [1]. Following data analysis and comparison, it was concluded that the amount of learner-to-learner engagement in PBL and team learning was comparable to and much greater than in lecture, where most engagements

were of the learner-to-instructor and self-engagement types, while learner-to-instructor engagement appeared to be greater in team learning than in PBL.

To capture comprehensive pictures of teachers' behaviors in bilingual classes, Lara-Alecio and Parker developed a pedagogical model called Transitional Bilingual Observation Protocol (TBOP) for the exploration of teachers' instructional delivery and students' engagement in class [12]. This four-dimensional model was based on the four-dimensional pedagogical theory lifted by Lara-Alecio and Parker, which consisted of four dimensions: (a) Activity Structures, (b) Language of Instruction, (c) Language Content, and (d) Communication Mode [12]. For decades, to achieve the objectives of teacher training and guidance, program assessment, and empirical validation of bilingual theories, TBOP has been utilized in a variety of disciplines in bilingual education, ESL education, and EFL education.

For the field of problem-based learning, Tang et al. adopted TBOP for their comparative study on problem-based learning and traditional instructional management in English classrooms at the college stage in mainland China [5]. Two graduate assistants used TBOP-based observation to code six observation videos of two classes during their research process. After the coding process, each video turned out to contain 60 coding sets, leading to the phenomenon that 360 coding sets were included in the research analysis. After the data analysis, the findings revealed that using PBL methodologies in an EFL classroom did not significantly alter teachers' pedagogical practices, failing to meet the objective of giving students additional opportunities to develop their expressive English language skills.

In general, some interesting inspirations can be found in the preceding literature when using an observation protocol that is not specifically designed for PBL. First, PBL and some classroom observation instruments were discovered to have similar origins. Since the PBL model is generally thought to have evolved from the instructional management of medical education[7], it is interesting to note that there are also classroom observation tools that arose from the demand for the promise of education quality in medical education settings [11][13][14], implying that all of these pedagogical improvements and observation instruments are created to ensure students' professional outcomes after the academic trough. Second, different aspects of PBL assessment should be given full attention, meaning the research methodology could include observation protocols containing various observation aims. For the devotion towards studies on teacher instructional behavior and student engagement, O'Malley and Moran adopted STROBE as the main instrument [11], while Tang also indicated the importance of the use of subject-centered classroom observation instruments [5]. As PBL is implemented into various curriculum management, observation tools should also follow the trend contemporarily.

4 Research Adopting Observation with no Clear Instrument Applied

When digging deep into the instruments of each observation-based PBL study, there are studies including classroom observation as a part of the mixed methodology, which does not show clear observation tools through the literature statement but is also worth discussing [2-4].

Remedios, Clarke, and Hawthorne paid great attention to collaborative behaviors during the PBL process [2], since small-group collaborative learning works as a fundamental element in the PBL approach [15]. To acquaint further comprehension of students' collaborative behaviors and attitudes in group words, they conducted a study in a school of different racial and cultural backgrounds, where a hybrid PBL curriculum had been implemented ever since 1999. Researchers used a complex methodology that included ethnographic approaches, classroom observation, and semi-structured interviews to map a general print of collaborative behaviors and attitudes of students involved in this school-based hybrid PBL program. The classroom observation part during the whole research process consisted of a two-year participant observation study and videotape observation. The former one was conducted during PBL tutorials, PBL tutor-training sessions, and tutor meetings, while the latter one contained data collected from recording videotapes of a total of 42 PBL tutorials during students' first year of study. After the two-year participant observation as planned, a single semi-structured interview was designed according to field notes driven from the practical field stage. Therefore, after this semi-structured interview, videotape analysis of PBL sessions proceeded and afterward observation-stimulated recall interviews were conducted. And as the results of this study, it was found that students in the hybrid PBL programme recognized that speaking shares greater privilege compared with listening when it is related to collaborative learning in group work.

In Trinter et al.'s study of the mathematical promise of students including those who are from underserved groups engaging in PBL units at the primary stage [3], classroom observation was based on tapes recorded by high-technology equipment, which did not adopt a typical observation tool, either. In this study, video observation also took part in the mixed methodology, and the materials of video notes, interview notes, and students' writings were all coded based on the same data reduction methodology designed by Miles and Huberman [16], namely a contact summary sheet. Based on the data analysis, results indicate that students show characteristics together with attributes indicating mathematical promise as lifted by Sheffield within a PBL-based context [17].

According to the above review of related literature, the observation study played various roles in the overall structure. The study by Remedios and his colleagues provides an appropriate example of how observation matters in a mixed design of methodology in PBL research [2]. Although classroom observation played a minor role in the structure, the combination of field and videotape-based observation greatly influenced the practical process of the study. Furthermore, in Trinter's work [3], observation

notes were viewed as data sources, with no special attention paid to the characteristics of this real data derived from teaching videotapes. In the preceding study, classroom observation was included as part of the research and served as supplementary evidence.

5 Implications

After the review of the literature, several implications and suggestions could be lifted for later scholars to consider.

First, while classroom observation can provide reliable clues for interactions that occur in real-world classroom settings, few studies use it as the primary methodology component. As a result, despite the mature development of STEM PBL, no specially designed instrument for PBL observation exists. As a result, it is worthwhile to make future efforts to focus more on observation studies in PBL.

Second, stakeholders, especially tutors involved in PBL, could be conductors of field observation, which is calling for the development of academic observation tools and a research-based teacher training program to guarantee the qualification of each researching teacher. Building up teachers' PD is another vital factor in insure successful progress in PBL programs and studies.

Third, the observation studies presented above did not present the issue of covering insights about the intro part before defining the problem and publishing specific products. As a result, it is still worth investigating how to use classroom observation instruments to analyze these two significant elements.

6 Conclusion

After reviewing previous literature based on classroom observation studies, this article has output a general catalog of practical observation instruments used in PBL studies. The special observation instrument designed especially for STEM PBL activities indicates great concern about teachers' professional development and abilities of instructional management, while also focusing on students' academic products after PBL. Besides this special protocol, other tools share a common interest in teachers' practical behavior and students' engagement in real PBL classrooms, which emphasize the importance of observing real classroom interactions. Generally, observations can provide sufficient evidence for deep research in composite studies and offer inspiration for later interviews or questionnaires. The above findings compromise neatly with the aims of reviewing previous observation protocols in PBL studies, by making a retrospect on the special observation tool designed for PBL classrooms and other types of observation instruments. The review argues the feasibility of using classroom observation in the methodology of PBL studies and demonstrates the lack of use of formal classroom observation tools in the PBL domain. As a result, researchers who are committed to implementing various measures to improve the assessment of PBL settings would benefit from this review article and could consider conducting additional observation studies using formal observation tools or developing an innovative protocol for PBL classroom settings. Researchers will be able to continue PBL-related

research with richer and more scientific research methods if they understand the status quo of classroom observation in PBL research and clarify their professional observation tools.

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