A Digital Application Prototype on Self-help Project-Based Learning

Binhao Jin¹,*
¹College of Art and Design, Guangdong University of Finance and Economics, Guangzhou, Guangdong, China, 510320

*Corresponding author e-mail: jinbinhao@gdufe.edu.cn

Abstract. “The key feature of project-based learning is that students develop autonomy and responsibility for their learning.” But how to support students with “newly gained freedom and autonomy” to “overcome and solve their problems and difficulties” [1] is still a challenging question to students and teachers. This paper aims to develop a self-help learning and instructing framework shared by teachers and students, which will be a digital application prototype to assist teachers to provide guidance and support for students to overcome learning difficulties by themselves in project-based learning. The results of students questionnaire show that the self-help framework is an effective way of fostering students’ learning skills such as cooperation, communication and reflection, which defined by PBL. More importantly, it freed teachers from ‘teaching’ knowledge and skills to observing, auditing, reacting from time to time with students as a more democratic role, in which students got more chances to learn by themselves in classroom, in another word, more actively, autonomously and independently.

Keywords: Pbl, Prototype, Self-Help, Framework

1. Introduction
Projects method or project-based learning(PBL) has been explored in various contexts and in different phase of schooling, ranging from the early stages of education through (even preschool) primary and secondary school to higher education [2] all over the world e.g Hungary, Sweden, Greece, Turkey, US, Oman, UK, Israel and Taiwan [3] [4]. Although there is no firm evidence proved that PBL has superior advantages than the traditional method(only transmission way), it “is a most popular method of instruction than traditional method” by “direct and indirect evidence” [1-3]. However, a review of research(ranging from 1990 to 2000) shows that both teachers and students face difficulties or challenges during PBL implementation, which point to the joint need of more effective scaffolds on learning and instructing. Another review of the literature(ranging from 1998 to 2015) also shows that students and teachers need more effective support to
use PBL approach successfully\cite{4,6}. So is it possible to build a shared learning and instructing framework for PBL which will offer guidance and support for both teachers and students to work together on projects and benefit from PBL? To answer the question, this paper will discuss it by five sub-questions which are:(1) What is PBL?(2) Why do students and teachers need such a self-help framework for PBL?(3) What is the self-help framework for PBL?(4) How do students and teachers use the self-help framework for PBL?(5) What is the mutual benefit for students and teachers by using self-help framework?.

2. What is PBL

PBL is the abbreviation of either project-based learning or problem-based learning. This paper will be focused on the discussion of project-based learning rather than problem-based learning since problem is the sub-domain of project from the perspective of typology. PBL has a very long history of development traced to 16th Italy and 18th century\cite{4} and has many names e.g. project (Apel & Knoll, in press), project method (Kilpatrick, 1918), project-centered learning\cite{5}(Gerald G. Duffy, Robert C. Putt, 1969), project-based instructing (Krajcik, Blumenfeld, et al., 1994), project-based learning (Sawyer, R.K., 2006) if we regard project as a method of learning or teaching. And the content of PBL has been constantly studied, enriched and developed till today. In order to construct a general view of PBL, this study will exam eleven authors’ (from Kilpatrick 1920’s to Dimitra Kokotsaki 2016) definitions of PBL or other named, from which the keywords will be collected and classified to construct overview of PBL as the theoretical basis of the self-help framework which will be described later. By classification of the key words collection we got a comparatively though description of PBL is that it is one of comprehensive teaching and learning method with the advantages of students’ better involvement, interest and commitment in classroom, which is based on the core value of student-centered and teacher-promoted, with the purpose of developing students’ responsibility and autonomy, democratic character and personality on learning attitude, and problem-solving on learning skills including goal-setting, investigating, cooperating, designing (visualizing), communicating, decision-making and reflecting, characterized by the elements of driving questions, real-world practice, real-life problems, authentic content and assessment, considerable length of time, and an end product.

3. Why do students and teachers need such a self-help framework for PBL

One of the key features of PBL is that there must be real-life or authentic problems (Phyllis C. Blumenfeld, Elliot Soloway, et al., 1991), which are typically complex and ill-structured (D. H. Jonasson, 1996) for both students and teachers. The unknown or ill-structured problems hidden in project are very much like a ‘Black Box’. Teachers generally are well-trained professional and experienced people who is able to deal with those problems in their own manner, but they are uncertain that students could or could not, and it is especially challenging that a whole class of different students faces different problems. It means that teachers need not only to design “scaffold”\cite{6} to support students to solve the problems, but also teachers themselves need to think and learn how to solve the new problems in project with which they are confronted each time. So a self-help problem-solving framework for project is very necessary for both teachers and students, which will not only support students to learn, but also offer teachers the clue of instructing students to learn how to learn. More importantly, it will free teachers from ‘teaching’ knowledge and skills to observing, auditing, reacting from time to time with students as a more democratic role, in which students got more chances to learn by themselves in classroom.

4. What is the self-help framework for PBL

The self-help framework of PBL (figure 1) is an iterative prototype or open system for learning and instructing based on projects, with preset multi-level modules, which could be linked freely in horizontal
level as needed. It mainly consists of five related, not necessarily sequenced, modules (Importing, Thinking, Learning, Acting, Exporting) and a number of sub-modules. The framework could be used as a menu based on a series of options by which teacher(s) could start from Importing module by choosing an imported subject/project/topic, ..., and students and teachers may choose to go to the next Thinking module by discussing the sub-module questions (What, Why, How, ...), or go to the Learning module by visiting or observing a new place to initiate students’ interest on the subject, or even go to the Acting module by planning a short tour in group to gain some experience before thinking any questions. No matter what choices have been made, students, teachers, or both need to consider the time schedule carefully in order to benefit as much as possible from the project, and most importantly, students need to submit (Exporting module) a designated form of works such as a mind map or a plan as a result of any activities, which will form the basis of next step, and students and teachers will go back to any module to continue thinking, learning, or acting to iterate till the end of project or time. In addition, each module or sub-module is allowed to generate a certain number of lower-leveled module or options based on the complexity of projects or problems and students’ ZPD (zone of proximal development) [6]. The following part of the paper will elaborate the five first level of modules as for the further understanding of the framework.

4.1. Module1-Importing
The Importing module is the preparation of the whole project. Teacher(s) are mainly responsible for choosing a subject of the project for students to limit the scope of projects in consideration of limited time and effect, with which commonly are the fields or industries that teachers are comparatively familiar. Generally, teacher(s) and students also need to subdivide the subject into smaller modules or lower levels to work on such as projects, topics, issues, tasks, items and so on to reduce ‘cognitive load’ [2] as an easier starting point. In general, the levels of subdivision of the chosen subject depend on the average level of students as teacher(s) find out or perceived during the process of implementing project. It should be noted that teachers do not necessarily subdivide it in the beginning but derived gradually from the discussion of the subject in the later modules of Thinking, Learning or Acting because it is worthy of us doing so from the perspective of PBL core value of constructing knowledge autonomously.

4.2. Module2-Thinking
The Thinking module is served as thinking scaffolds for helping teachers to guide students to ask or find the ‘driving questions’ themselves. It could be used as the next step of Import module and be applied to any other modules or sub-modules of the framework as needed as well. The Thinking module consists of four basic aspects of questioning including What, Why, How, and Next, which will lead students to think deeply and comprehensively. Teachers also could develop more sub-modules in light of students’ levels containing, among other things, subject, projects, topics, issues, tasks, items, concept, content, form for What module,
purpose, significance, and values for Why module, and principles, methods, medium, tools, materials, process and steps for How module, and result, conclusion and tasks for Next module.

4.3. Module3-Learning
The Learning module is a series of skills for students to collecting new data, getting new information, learning new knowledge and verifying new ideas which are prepared for solving problems and answering questions. It could be used as the next step of Thinking module and be applied to any other modules or sub-modules of the framework as needed as well. The Learning module consists of six basic aspects of learning including Observing, Understanding, Visualizing, Applying, Exchanging and Reflecting, which will lead students to learn from a variety of materials or resources searched by themselves and authentic context they were in. Teachers also could develop more sub-modules in light of students’ levels containing, among other things, watching, listening and feeling for Observing module, searching, selecting, reading, noting, sorting, classifying, prioritizing, and analyzing for Understanding module, sketching, building and brainstorming for Visualizing module, operating, making, prototyping and producing for Applying module, showing, sharing, describing, questioning, reacting evaluating and judging for Exchanging module, summarizing and inducing for Reflecting module.

4.4. Module4-acting
The Acting module is the implementing part of all the other four modules, consisting of five necessary tasks for team work and management in project including Discussing, Decision-making, Planning, Organizing and Cooperating, which will guide students work as a team to complete specific work needed for solving problem. The Acting module could be used with any other module or sub-module to export working results. Generally, a teamwork division table is needed and very helpful to improve efficiency of students’ learning and doing.

4.5. Module5-exporting
The Exporting module is the results of all the other four modules, consisting of four basic aspects of results in project, including Data, Information, Knowledge and Works, which will guide students to export audio-visual and effective results such as notes, pictures, audios, videos, tables, charts, figures, plots, diagrams, graphs, schedules, sheets, mind maps, knowledge maps, sketches, drawings, models, prototypes, artifacts, products, papers, theses. These results are very helpful for students to save, transmit and share data, information and knowledge gained from projects, to understand, evaluate, judge and reflect the works they have done, eventually to promote cooperative and social learning in projects.

5. How do students and teachers use the self-help framework for PBL
To illustrate the usage of the framework as a reference, this research will present a learning and instructing example designed for product design class with 30 junior college students and 1 teacher (author) for lasting 2 hours long. The learning and instructing process is, shown in Figure 1, following the direction of arrows, and the learning and instructing modules used in the process marked with bold text. During most of the time the main work of the teacher was walking around the classroom, checking their time schedule, observing and auditing the class, and sometimes join the discussion of some groups to push them to move forward, and the main work of the students were immersed in the tasks they planned in time schedule. Details of the process is shown below and in Figure 5.

5.1. Importing
Teacher showed the following information to the whole class and told students it was a challenging project that they would have to work with 3-6 years old children in kindergarten. But firstly they could ask any questions about it since it is very much challenging work they were supposed to do.

Subject: Product and Service Design for children in kindergarten
Project: classroom activities design
Topic: what should we know about the project?

5.2. Thinking
Students think what questions should be asked about the project before starting it.

5.3. Learning
Task 1. Students search the web to understand the concept of 5w2h in 5 minutes and learn how to ask questions by using the 5w2h method individually.
   Task 2. discuss the the upper topic with teammates by brainstorming(students already learned) and write all the questions that each member wants to ask as many as possible.
   Task 3. students teams use 5w2h as a tool to sort out the questions in key words by using the materials of post-it on the wall.
   Task 4. turn them into electronic version by using any mind map application.

5.4. Acting
Students organize a team (2-4 persons) with their classmates, and discuss the 4 tasks and make a 1hour working plan on paper, and cooperate with teammates to finish the 4 tasks following the plan.

5.5. Exporting
Each students’ team need to export a ‘mind map’ as the result of team work.

| Teacher(s) | Teacher(s) + Students | Students |
|------------|-----------------------|----------|
| Importing  | Thinking              | Learning |
| Subjects   |                       |          |
| Projects   |                       |          |
| Topics     |                       |          |
| Issues     |                       |          |
| Tasks      |                       |          |
| Items      |                       |          |
| ...        |                       |          |
| What       | Observing             |          |
| Why        | Understading          |          |
| How        | Visualizing           |          |
| Next       | Applying              |          |
|            | Exchanging            |          |
|            | Evaluating            |          |
|            | Reflecting            |          |
|            | ...                   |          |
|            | Drawing               |          |
|            | Brainstorming         |          |
|            | ...                   |          |
|            | Discussing            |          |
|            | Decision-making       |          |
|            | Planning              |          |
|            | Organizing            |          |
|            | Cooperating           |          |
|            | ...                   |          |
|            | Data                  |          |
|            | Information           |          |
|            | Knowledge             |          |
|            | Works                 |          |
|            | Tables                |          |
|            | Charts                |          |
|            | Figures               |          |
|            | Plots                 |          |
|            | Diagrams              |          |
|            | Graphs                |          |
|            | Mind maps             |          |
|            | Schedules             |          |
|            | Sheets                |          |

Figure 2. Process of using the framework.

6. What is the mutual benefit for students and teachers by using self-help framework
The framework designed by authors has been used in 2 classes of sophomore, 2 classes of junior, and 2 classes of senior with average persons of 25 students in each class. The result of the learning and instructing observed by teacher himself(author) is similar to what happened in a ‘flipped classroom’ but in a off-lined
version, in which students always ignore the existence of the teacher once they started to work according to the time schedule made by themselves, especially with tasks defined clearly by subdividing working modules. Another additional result is the teacher's ranking given by students from the university’s on-line system moved up from 18th to the 2nd among 51 teachers at the school of art and design after one year 4 classes of usage of the framework.

The teacher also had made a semi-formal anonymous questionnaire in one class, and finally distributed and collected 25 valid questionnaires. The result was that most students were believed that the most important learning experiences in key words and their votes are:(1) Teamwork, or division of work, cooperation, or capability of cooperation(18-25 votes out of 25)(2) Analyzing in depth, or analyzing and summarizing(18-25 votes out of 25)(3) Scientific methods, investigation method, or brainstorming method, logic and method, new ways of thinking, thinking abilities, or logical reasoning(18-23 votes out of 25)(4) Enough time to cooperate and communicate, rate of time utilizing in class, time control, or efficiency(16-23 votes out of 25)(5) Organizing information, or information collection, or information integration(22-23 votes out of 25)(6) High participation, or engagement, or involvement(21 votes out of 25) (7) Communicate (17-21 votes out of 25) (8) Optimizing and iteration of learning(21 votes out of 25)(9) Instant feedback from others including students and teachers(20 votes out of 25)(10) Inquiry autonomously, or freedom of study (19-20 votes out of 25)(11) Developing individual fullest potential, make good use of individual talents(14-19 votes out of 25)(12) Reflections of learning problems(18 votes out of 25)

The result of questionnaires matches the features of PBL mostly, especially on the values of student-centered and teacher-promoted, on the learning attitude of autonomy, on the learning skills of cooperation, communication and reflection, and on the advantages of students’ involvement. To some extent, the framework had been partly proved effective and suitable for PBL.

7. Conclusion
In this paper, a self-help framework for PBL with five modules and multi-level sub-modules and its application results were presented. The outcome of students’ learning verified its effectiveness and efficiency to some extent. The following conclusion can be made:

(1) A preset framework for PBL is very helpful for teacher to guide students to learn independently.
(2) Modular design of the framework will make its usage more flexibly and easily by teachers and students.
(3) The self-help framework is supposed to be enriched, updated and iterated as projects.
(4) Teachers can ‘teach’ less, and motivate more if they really want to.

Acknowledgments
This research has been financed by The Teaching Quality and Teaching Reform Project in 2020 of the Guangdong University of Finance and Economics “ Research on the Self-help Learning Mode Characterized by Agile”.

References
[1] J. Alistair Morgan, Theoretical Aspects of Project-Based Learning in Higher Education, 1st ed., Vol. 14, British Journal of Educational Technology, 1983, pp. 66-78.
[2] J. Dimitra Kokotsaki, Victoria Menzies, Andy Wiggins, Project-based Learning: A review of the literature, 3rd ed., Vol. 19, Improving Schools, 2016, pp. 267-277.
[3] M. John W. Thoomas, “A review of research on project-based learning”, unpublished.
[4] J. Michael Knoll, The Project Method: Its Vocational Education Origin and International
Development, 3rd ed., Vol. 34, Journals of Industrial Teacher Education, 1997, pp. 59-80.

[5] J. Gerald G. Duffy, Robert C. Putt, Have a Place in the Modern Classroom, 6rd ed., Vol. 46, Peabody Journal Education, 1969, pp. 352-354.

[6] J. Roehler, L. R., & Cantlon, D. J. (1997). Scaffolding: A powerful tool in social constructivist classrooms. Instructional approaches and issues (pp. 6-42).