Price and Prejudice: A Case Study of College-level Project-Based Learning Program in a Shanghai International High School

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ABSTRACT
Project-based learning (PBL) is usually based on real-world issues and emphasis on students' soft skills, including autonomous learning, collaboration, problem-solving, information seeking and evaluating. Many studies have been done to investigate the use of PBL in different stages of school, from kindergartens to universities and pre-service training. Some current studies are writing a trend of introducing college-level education, especially about social studies and research techniques into high schools, but seldom of them were putting this trend into practice. This study used a case study with interviews and surveys to examine such a PBL program in an international high school in Shanghai, China. This research shows the effectiveness of this PBL program in some areas while raising questions in other aspects of learning, which may help to suggest issues and direction for improvement, update current understandings of high school students' ability, and enlighten education.

Keywords: *Project-Based Learning, Collaboration, Autonomous Learning*

1. INTRODUCTION

This paper aims at investigating the project-based learning program of Shanghai Pinghe School, which is one of the schools to first incorporate college-level research into the graduation requirements of high school students. The school has employed more than five instructors with doctoral degrees or higher. Most of the teaching assistants also have master's degrees or higher. The core curriculum of this PBL program provides detailed instructions and support for student-centered learning. Students put much time and effort into their projects. They attend an 80-minute lecture and upload assignments each week. Students are usually asked to write a part of a formal research paper, such as abstracts, literature reviews, and methodologies for homework. Their research methods include field research, interviews and surveys. Instructors introduced research methods, share research experiences, and offer feedback in class. Students frequently shared their designs and results with oral presentations in the middle of or at the end of semesters. Students must complete a full research article each semester or each year.

In contrast to the money and efforts, most students reacted passively to this program. Therefore, identifying issues within such a pioneer PBL project can help revolutionize the current understanding of the ability of current high school students, enlightening high school education, and even perhaps reducing the time for education before college.

2. METHOD

The study used semi-structured interviews to obtain data on students' subjective opinions. The population studied was all the students in Class 9, 10, and 11 in Grade 12, except for transfer students. The interviewees were of both genders and from both the Artificial Intelligence Track and Social Studies Track. Seven interviewees were selected based on the principle of Informational Saturation – stop interviewing when the information collected from interviewees start to repeat and new information was obtained. The key questions of the interview include self-reported motivation, feeling during class, and learning outcomes.

Interviews were analyzed according to Grounded Theory, a research method [2]. This study suggests a systematic set of methodologies for collecting and analyzing qualitative data as Charmaz mentioned [3]. This study also bridges between empirical studies'

theoretical construction as Corbin and Strauss proposed [4]. Researchers needed to analyze data while collecting.

3. LITERATURE REVIEW

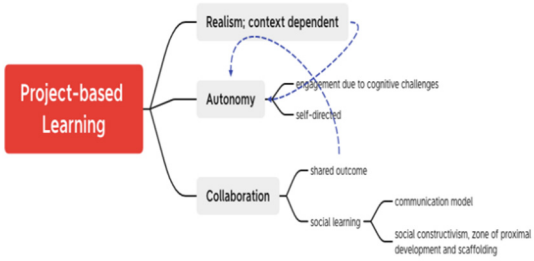

Figure 1: Theoretical framework of Project-based learning

In a typical project-based learning program, students identify or encounter a problem from their life, refine it, design and conduct investigations, draw conclusions from the data they get and present their results with an end product. There is a "concrete artifact" [5]. It includes videos, photographs, reports, models, etc [6]. According to Blumenfeld, Fishman, Krajcik, Marx, and Soloway, project-based learning has a presumption that students need this research-like way of learning to construct their knowledge [7].

Most of the studies on project-based learning do not involve randomly dividing participants into experimental and control groups and focus on observing students' behavior and attitude, analyzing quantitative data representing students' accomplishments in standardizing tests [8][9]. For example, concluding self-report surveys. Sweller, Kirschner, and Clark have emphasized the importance of randomness and controlled experimental studies with different instructions for more reliable evidence on the effectiveness of project-based learning [10].

PBL is summarized to have three basic characteristics.

The first is context-dependent learning. According to Brown, Collins, and Duguid, learning is highly influenced by the context and activity in which it is embedded, so students should get involved in the context during learning [11]. Drain argues that learning is maximized when it occurs in real-life contexts and students engage with authentic problems [12].

The second characteristic of PBL is that the learning of students is autonomous, which corresponds to the autonomous learning suggested by Bruner [13]. Zimmerman and other scientists summarized the theoretical framework of autonomous learning in Table 1 and made the definition: If students can control all four aspects in column 3, then it is autonomous learning [14][15].

The internal mechanism of autonomous learning was suggested by Winne and Butler through an information processing viewpoint [16][17]. First, students explain tasks with four kinds of knowledge: domain knowledge, task knowledge, strategy knowledge, and motivational beliefs. Next, students set learning goals, including mastery goals and performance goals, and use them to orient learning and adjust learning processes. Then students choose and utilize appropriate learning strategies, including cognitive strategies and volatile strategies. Finally, students generate learning both psychological and behavioral outcomes.

One method of acquiring autonomous learning ability was suggested by Schunk [18]. Students learn through a sequence of actions consisting of practice, imitation, and self-control to reach autonomy [18].

Another series of methods was suggested by Winne that students can gain this ability from everything: teaching; observation; self-designed and conducted learning experiments, in which students learn through either of the two forms trials and errors, with goals without systematic plans and with both goals and systematic plans) [19].

A high level of student engagement is suggested to arise from the cognitive challenge as well as the effective, ethical, and aesthetic dimensions of a project. It is argued that it can help foster self-regulated learning and can promote pupils' conceptual knowledge within a systematic process of documenting and reflecting on learning [20]. Students learn to be self-reliant through goal-setting, planning, and organization; they become intrinsically motivated because they can make responsible choices while learning at their level [21].

Similar to experiential learning, project-based learning requires active reflection and engagement of students. Ruikar and Demian made a connection between industry engagement and multimedia podcasting in the United Kingdom [22]. Stewart found that self-directed learning readiness, such as self-management skills, was a key for success in PBL [23]. Research with 14- and 15-year-old girls in Israel showed increased interest in learning STEM subjects [24]. Doppelt found that scientific-technological PBL helped improve low-achieving students' motivation and self-image by allowing early success [25]. However, in their quasi-experimental study with 13-year-old children (Grade 8) taking computer courses in Greece, Boubouka and Papanikolaou found no significant effect of PBL on student achievement but a statistically positive effect on self-perceived learning performances [26].

The last characteristic of PBL is that students need collaboration to achieve a shared goal. This assumption suggests that learning requires communication and social activities. Communication models provide understandings of the process of communication: The

inference model of communication suggests that listeners infer what the speaker is intending based on the context [27]. the simulation model of communication involves communicators generating images while transmitting and receiving information [28].

The Zone of Proximal Development (ZPD) refers to the difference between the developmental level at which the learner can solve the problem independently (actual developmental level) and with cooperation and guidance (potential developmental level [29]. These supportive social activities are defined as scaffolding by Vygotsky [29]. Social constructivism holds that learning takes place at the level of potential development, which comprises cognitive functions that are maturing and can mature only under guidance or collaboration [29].

Other studies focus on the role of teachers in the success of project-based learning, including scaffolding students' learning, clarifying goals of the PBL, offering examples of the desired response, emphasizing interdisciplinary applications, aligning assessment with the unique features of the PBL process and outcomes (Lehman, George, Buchanan, & Rush, 2006) [30][31][32][33].

4. ANALYSIS

Three categories were generated from the data:

4.1 Soft and Transferable Skills

4.2 Innovations and Personal Development

4.3 Physical Outcomes

4.4 Reflection on One's performance and Attitudes in Class and Outside the Classroom

4.1. Soft and Transferable Skills

Most of the participants claimed that they had developed their collaboration skills. The PBL curriculum began at the first semester of grade 10, which was the time when Chinese students entered high schools; the curriculum was the first time for most of the students, who had studied in a traditional Chinese education system, to experience intensive group work assignments:

"You know, since most of us were just about to enter high school at the beginning of the course, and this was really our first exposure to an international study." #1

Many participants agreed with the existence of a communication barrier. Below is from a team leader:

"It was quite embarrassing initially because I was speaking and nobody answered or they just nodded their heads. And I didn't know how do they like…… my ideas as well. You know, sometimes what I said was just stupid, but they just nodded."

Leaders were not the only students facing this problem. Also, group members wanted the leader to share their opinions:

"Although I did show my opinions in meetings, I never added to others' opinions, so they thought they could not know what I was thinking and better contribute to the project." #1

Some suggested that they got opportunities to review his or her attitude and communication styles while exchanging ideas to make others feel more comfortable and willing to share opinions:

"This was the first time that I realized that while I was trying to talk to my groupmates, and that although I thought I was friendly, actually my attitude was not that open to foreign opinions – after several group meetings, we (my group members and I) got familiar with each other, and they said that they thought my attitude was a bit annoying, which was surprising to me……" #1

"They said that I kept asking them questions and using single-syllabus words for answering, which made them think that I was inpatient." #2

"Sometimes they (group members) said that I went through concepts too quickly, and some of my descriptions were not that clear." #3

After identifying these potential issues and barriers for communication, participants suggested that they had developed ways to solve problems, which added to more effective and efficient communication as a basis for group work:

"Then I explained what I think and asked others their opinions whenever we overcome something new." #1

"So later when I receive their opinions, I tried to say something." #2

"I usually speak with freestyle according to

my notes with bullet points… I started to write a word-to-word script — with a more accurate diction and syntax and some more comprehensive examples — for the things I wanted to say at group meetings, and I practiced by speaking to my parents to see if they understand." #3

It was the first time for many interviewees to be team leaders as well. Most leaders agreed to have difficulties with assigning tasks:

"Yes, for most of the assignments, I did all the work." #1

"I did most of the work." #3

Some team leaders suggested that this was because they were worried about their relationships with and impressions of group members:

"I was afraid to assign tasks to all of my team members because I thought they would be unwilling to do

so and assigned work might even make them dislike me." #4

Some leaders didn't believe in team members, due to either the impunctuality or poor ability to do high-quality work:

"I didn't trust their ability as well; I thought

they could not do a good job." #3

"One of us (the group members) once said

that he would love to take charge of a task, but later when we needed to turn it in, he either said he was taking a class or just did not reply to us. But when the teacher asked who was ready to submit the work, he immediately replied that we were — though we weren't ready at all." #1

Another issue for assigning work was the limitation in time and place. Since the deadline for each week's work was usually 23:55 every Sunday, students tended to leave their work for the weekend, when they could not discuss or work in person.

"……so we usually did not have an opportunity to discuss each other's work before submission." #3

Even facing these difficulties, leaders were still trying to make sure the learning opportunities for group members.

"But I was struggling as well because I thought I didn't even offer them enough opportunities to do their work and to learn on their own." #4

Some of the leaders suggested that they found a balance between high-quality work and ensuring the participation of each member.

"For each week's task, I split it into several

parallel parts — so we could do work simultaneously, or if one of has had to wait for the other to finish, one's procrastination might cause all of us missing the deadline — so each of us could try a part of the. For example, when we needed to write a literature review in two weeks, I would tell them to write a list of articles they found useful and read and wrote a brief analysis about some of the ones they selected, so at the end of the first week, we could share our findings. Then for the second week, I would browse through the list of articles to determine which to keep and assign them to group members to read and write an analysis. Finally, I combined our work." #3

"I designed tasks based on their interests…… One of us was learning AP Government and Politics, so I let him study the policy part; another was a Youtuber, so she read about production process and communication." #5

"I wrote the questions for structured

interviews, as well as invited interviewees and let some of them (group members) do the interview and send me recorded audio of the interview. This worked." #1

"I started to use tools for collaboration

such as Google Drive, Shimo Document, Jinshan Document, and even the shared function of Mac's Notes, Pages, and Keynotes. When we needed to do a presentation, I would create a template on Google Drive for others to follow." #2

Apart from leadership and communications within groups, many participants claimed that they developed their skills for searching for sources, writing papers, and public speaking.

"It could save a lot of time by reusing the

template on Google Drive, and the ppt (PowerPoint) is still of high quality." #3

"…… (while reviewing our Powerpoint for the final report), she (teacher) always suggested we use larger sizes (of words on ppt) and use red, blue, and underline for emphasis." #1

4.2. Innovations and Personal Development

Participants explored different areas in social sciences (mainly social studies and anthropology) and gained a clear understanding of these academic areas.

Some of them determined to continue studying and to contribute to social sciences at college, and the experience the PBL curriculum served as an important role in their decision-making process and application material; while others realized that they do not want to study social sciences and could explain their reasons with evidence, which showed their understandings in social sciences.

"I applied for social sciences major for all the college I applied to…… no second major…… I submitted her (the PBL instructor) letter of recommendation." #1

"Although I never plan to major in social sciences…… because I'm not good at writing and reading with a second language (which is English), but I realized that anthropology was the subject that I really want to study. I wanted to do a field investigation among gangs." #3

"It's (sociology) not suitable for me. I'm not interested in social issues, and it's (sociologists are usually) poor. I don't want to think I'll not choose this major." #2

The PBL curriculum opened a window, especially for those who were interested in social sciences, to view the world with "social imagination".

"I loved to do talk to random people and observation for some groups of people…… PBL offers me the

methodology to collect data and to achieve more reliable conclusions, as well as an excuse for these seemingly meaningless activities — now I can say that I'm doing fieldwork or observational study." #3

"Currently I'm doing a project by interviewing people in my hometown. I'm quite interested in this issue, and I really appreciate this course for introducing me to such a subject to look deep into issues I', interested in." #1

4.3. Physical Outcomes

Although the PBL curriculum was initially designed for helping students with the application through gaining prizes such as China Thinks Big (CTB), publishing papers, etc., it hardly achieved these purposes. It is reasonable that students who only studied this curriculum in grade 10 for only one year did not publish papers.

"We were all active while paying the money (to enter for CTB), but by the time when we needed to turn in the proposal (or our research), only two of us (from all five group members), and nobody did work when it was the time for hand in the literature review. I just thought about this three hours before the deadline, so we gave it up." #1

Some supported this helped them with their application process, while others suggested that the curriculum was not that helpful.

"I submitted the abstract in extra information in Common Application." #1

"I wrote about an experience in PBL (for one of the essays prompts) for UC (University of California)." #4

"I wrote it in my EC (Extracurricular activity list) in Common App (Common Application) and UC (University of California)." #3

"It wasn't helpful for me, because it has no relation to my intended major." #2

"It killed my GPA." #6

4.4. Reflection on One's performance and Attitudes in Class and Outside the Classroom

Interviewees' reflection tended to be extreme, with most of the leaders reported to spend huge time and efforts in the tasks and participate more in class, while more group members said that they didn't participate enough in their project. This was partially due to how the group leader assigned the tasks, as discussed before. Another reason was that some students thought this curriculum was "meaningless" or irrelevant to their majors.

"I was active in class, asking and answering questions and taking notes; but I always started to work on the project two hours before the deadline, so I had to sleep late, often missed deadlines." #3

"Collecting data was too time-consuming." #5

"I was applying for a painting major, so I really can't understand why I have to do this; my group leader was very hardworking but I did almost nothing." #7

"I'm learning better when I'm listening to the lecture given by the teacher." #2

5. DISCUSSION

Overall, the PBL Core curriculum for the first generation in grade 10 seemed to be useful for the development of soft and transferable skills, including collaboration, leadership, science communication, and innovative thinking. It is also helpful for personal development and academic exploration of social sciences subjects, which is important for writing essays and determining intended majors for college application and futural career plans. However, this curriculum was not as useful as it was thought to be for helping people achieve physical outcomes such as prizes of competitions and publishing papers. The curriculum was not that suitable for students interested in majors outside social sciences, such as STEM and arts.

This research also shows that most of the students of the PBL curriculum do not need a context for constructing their knowledge, which opposed the presumption given by Blumenfeld, Fishman, Krajcik, Marx, and Soloway that project-based learning has a presumption that students need this research-like way of learning to construct their knowledge [1].

6. CONCLUSION

Overall, this research suggests that transferable skills for research and methodologies for social studies would be perfect learning objectives for this curriculum, and students could learn through applying what they had learned to real-world situations via their research projects. However, since this curriculum was not suitable for everyone, it should be an elective course, or at least offer two levels of teaching, which are transferable skills and methodologies. In addition, the percentage of group work should be reduced for study efficiency and participation.

REFERENCES

[1] Blumenfeld, P., Fishman, B. J., Krajcik, J., Marx, R. W., & Soloway, E. (2000). Creating Usable Innovations in Systemic Reform: Scaling Up Technology-Embedded Project-Based Science in Urban Schools. *Educational Psychologist*, *35*(3), 149–164. https://doi.org/10.1207/s15326985ep3503_2

[2] Glaser, B. G., & Strauss, A. I. (1967). *The discovery of Grounded Theory; Strategies for qualitative research*. Aldine.

[3] Charmaz, K. (2006). The Power of Names. *Journal of Contemporary Ethnography*, *35*(4), 396–399. https://doi.org/10.1177/0891241606286983

[4] Corbin, J., & Strauss, A. (2021). *Basics of Qualitative Research: Techniques and Procedures for Developing Grounded Theory 3rd (third) Edition by Juliet Corbin, Anselm Strauss published by SAGE Publications, Inc (2007) Paperback* (3rd ed.). SAGE Publications, Inc.

[5] Helle, L., Tynjälä, P., & Olkinuora, E. (2006). Project-Based Learning in Post-Secondary Education – Theory, Practice and Rubber Sling Shots. *Higher Education*, *51*(2), 287–314. https://doi.org/10.1007/s10734-004-6386-5.

[6] Holubova, R. (2008). Project-Based Physics – Physics Teacher Training Course. *The International Journal of Learning: Annual Review*, *15*(8), 253–264. https://doi.org/10.18848/1447-9494/cgp/v15i08/45893.

[7] Blumenfeld, P., Fishman, B. J., Krajcik, J., Marx, R. W., & Soloway, E. (2000). Creating Usable Innovations in Systemic Reform: Scaling Up Technology-Embedded Project-Based Science in Urban Schools. *Educational Psychologist*, *35*(3), 149–164. https://doi.org/10.1207/s15326985ep3503_2.

[8] Geier, R., Blumenfeld, P. C., Marx, R. W., Krajcik, J. S., Fishman, B., Soloway, E., & Clay-Chambers, J. (2008). Standardized test outcomes for students engaged in inquiry-based science curricula in the context of urban reform. *Journal of Research in Science Teaching*, *45*(8), 922–939. https://doi.org/10.1002/tea.20248

[9] Schneider, R. M., Krajcik, J., Marx, R. W., & Soloway, E. (2002). Performance of students in project-based science classrooms on a national measure of science achievement. *Journal of Research in Science Teaching*, *39*(5), 410–422. https://doi.org/10.1002/tea.10029.

[10] Sweller, J., Kirschner, P.A., & Clark,R.E. (2007). Why Minimally Guided Teaching Techniques Do Not Work: A Reply to Commentaries. *Educational Psychologist*, *42*(2), 115–121. https://doi.org/10.1080/00461520701263426

[11] Brown, J. S., Collins, A., & Duguid, P. (1989). Situated Cognition and the Culture of Learning. *Educational Researcher*, *18*(1), 32–42. https://doi.org/10.3102/0013189x018001032

[12] Drain, M. (2010). Justification of the dual-phase project-based pedagogical approach in a primary school technology unit. *Design and Technology Education*, *15*, 7–14.

[13] Bruner, J. S. (1961). The act of discovery. *Harvard Educational Review*, *31*, 21–32.

[14] Schunk, D. H., & Zimmerman, B. J. (1994). *Self-regulation of Learning and Performance*. L. Erlbaum Associates.

[15] Zimmerman, B. J., & Risemberg, R. (1997). Self-regulatory dimensions of academic learning and motivation. *Handbook of Academic Learning*, 105–125.

[16] Butler, D. L., & Winne, P. H. (1995). Feedback and Self-Regulated Learning: A Theoretical Synthesis. *Review of Educational Research*, *65*(3), 245–281. https://doi.org/10.3102/00346543065003245

[17] Winne, P. H. (1997). Experimenting to bootstrap self-regulated learning. *Journal of Educational Psychology*, *89*(3), 397–410. https://doi.org/10.1037/0022-0663.89.3.397

[18] Schunk, D. (1996). *Learning Theories*. Lawrence Erlbaum Associates.

[19] Winne, P. H. (1997). Experimenting to bootstrap self-regulated learning. *Journal of Educational Psychology*, *89*(3), 397–410. https://doi.org/10.1037/0022-0663.89.3.397

[20] Barak, M., & Asad, K. (2012). Teaching image-processing concepts in junior high school: boys' and girls' achievements and attitudes towards technology. *Research in Science & Technological Education*, *30*(1), 81–105. https://doi.org/10.1080/02635143.2012.656084

[21] Bell, S. (2010). Project-Based Learning for the 21st Century: Skills for the Future. *The Clearing House: A Journal of Educational Strategies, Issues and Ideas*, *83*(2), 39–43. https://doi.org/10.1080/00098650903505415

[22] Ruikar, K., & Demian, P. (2013). Podcasting to engage industry in project-based learning. *International Journal of Engineering Education*, *29*, 1410–1419.

[23] Stewart, R. A. (2007). Investigating the link between self directed learning readiness and project-based learning outcomes: the case of international Masters students in an engineering management course. *European Journal of Engineering Education*, *32*(4), 453–465. https://doi.org/10.1080/03043790701337197

[24] Barak, M., & Asad, K. (2012). Teaching image-processing concepts in junior high school: boys' and girls' achievements and attitudes towards technology. *Research in Science & Technological Education*, *30*(1), 81–105. https://doi.org/10.1080/02635143.2012.656084

[25] Doppelt, Y. (2003). Implementation and Assessment of Project-Based Learning in a Flexible Environment. *International Journal of Technology and Design Education*, *13*(3), 255–272. https://doi.org/10.1023/a:1026125427344.

[26] Boubouka, M., & Papanikolaou, K. A. (2013). Alternative assessment methods in technology enhanced project-based learning. *International Journal of Learning Technology*, *8*(3), 263. https://doi.org/10.1504/ijlt.2013.057063

[27] Gasiorek, J. (2018). *Chapter 6: The Inferential Model of Human Communication – Message Processing: The Science of Creating Understanding*. Pressbooks. http://pressbooks-dev.oer.hawaii.edu/messageprocessing/chapter/chapter-6-the-inferential-model-of-human-communication/

[28] Balaban, P., Jeruchim, M. C., & Shanmugan, S. K. (1992). *Simulation of Communication Systems (Applications of Communications Theory)* (1st ed.). Springer.

[29] Vygotsky, L. (1978). Interaction between learning and development. *Mind and Society*, 79–81.

[30] Hmelo-silver, C.E., Duncan,R.G., & Chinn,C.A. (2007). Scaffolding and Achievement in Problem-Based and Inquiry Learning: A Response to Kirschner, Sweller, and Clark (2006). *Educational Psychologist*, *42*(2), 99–107. https://doi.org/10.1080/00461520701263368

[31] Helle, L., Tynjälä, P., & Olkinuora, E. (2006). Project-Based Learning in Post-Secondary Education – Theory, Practice and Rubber Sling Shots. *Higher Education*, *51*(2), 287–314. https://doi.org/10.1007/s10734-004-6386-5

[32] Gresalfi, M. S., Barnes, J., & Cross, D. (2011). When does an opportunity become an opportunity? Unpacking classroom practice through the lens of ecological psychology. *Educational Studies in Mathematics*, *80*(1–2), 249–267. https://doi.org/10.1007/s10649-011-9367-5

[33] Grant, M. M., & Branch, R. M. (2005). Project-Based Learning In a Middle School. *Journal of Research on Technology in Education*, *38*(1), 65–98. https://doi.org/10.1080/15391523.2005.10782450