

Critical Thinking Development Through Project-Based Learning

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Abstract—Project-based learning has drawn increasing attention from educators and researchers because of the multiple benefits it provides. Successful project-based learning engages students in deeper learning by using language as a tool to empower discoveries about the language itself, content, and various skills in authentic contexts. Using the revised version of Bloom's Taxonomy as its analytical framework, this study examined whether project-based learning promoted EFL college students' critical thinking and how students demonstrated their thinking skills through a book report project in a reading course.

Index Terms—project-based learning, reading, critical thinking

I. INTRODUCTION

Project-based learning (PBL) was introduced into the field of education by Kilpatrick (1918) more than 100 years ago. As an experiential learning method, it is consistent with the "learning-by-doing" concept of American philosopher and educator John Dewey (Dewey, 1926). As a learner-centered approach, it engages students in deeper learning by using language as a tool, not only enabling students to learn more about the language itself, but also empowering them to learn more related content and various skills in authentic contexts.

Research on project-based language learning began in the 1970s (Eslava & Lawson, 1979). In the 1980s and 1990s, the research on PBL gradually expanded from practice to theoretical research (Beckett, 1999; Eyring, 1989; Stoller, 1997). The influence of PBL on the theory and practice of second language and foreign language teaching also gradually increased. In the 21st century, PBL research has been furthered by scholars such as Fried-Booth (2002), Beckett and Miller (2006), and Beckett and Slater (2005, 2018, and 2020). Research by these scholars greatly promoted project-based learning and teaching. The application of PBL in the foreign language field in China started relatively late (Wang, 2020). Gu and Zhu (2002) appears to be the first article on PBL research published in China. Since then, scholars have been practicing and researching PBL, including investigations of the impact of PBL on language learning (Deng & Wang, 2009; Wang, 2013).

Additional research has considered the role of technology in PBL (Gu, 2007; Zhu & Zhang, 2011), the application and effect of PBL in higher education (Gao, 2010; Yu, 2017), professional courses (Zhang, 2012), and the use of PBL in language skills such as writing (Yang & Han, 2012). Zhang (2015) provided a localized PBL foreign language teaching model on the basis of long-term PBL practice. These studies confirm the positive role of PBL in foreign language learning. The approach not only pays attention to the process of learning, but also stresses the output results. Through PBL, learners' knowledge and skills, cooperation, and learning ability are fully integrated. Because PBL emphasizes putting students at the center and highlighting students' independent experience, teachers' roles also shift from more dominating to more facilitating roles. These studies show that PBL not only promotes students' learning of language-related knowledge, but also leads to other benefits such as supporting students acquiring content knowledge as well as cultivating students' cooperation and team spirit.

This study intends to explore the role of PBL in improving students' language and knowledge, critical thinking skills, independent exploration, and innovation ability so as to explore a new effective teaching model for foreign language teaching under the background of new liberal arts (Hu, 2020). More specifically, this paper examines whether PBL could effectively promote critical thinking at various levels through analysis of data from an academic project. The research questions guiding the present study include: 1) What kind of thinking skills did the participants demonstrate in the project-based learning involving oral and written activities? 2) Did the participants demonstrate critical thinking through the project?

II. RESEARCH METHODOLOGY

A. Participants and Data Collection

The participants of this study were second-year undergraduate students at a university in northern China. In the spring semester of 2020, 14 students were enrolled in this required reading course with texts loosely related to philosophy and civilization. The course met three times per week and lasted 16 weeks. Due to Covid-19 outbreak, the course was switched online.

In addition to the regular reading materials from the textbook, participants were required to make book reports. Three books roughly related to the topics discussed in the required textbook were chosen by participants and included: *The Crowd: A Study of the Popular Mind* by Gustave Le Bon; *Would you Kill the Fat Man?* by David Edmund; and *Educated* by Tara Westover. The participants formed groups of four or five students each at their own choice. Students were assigned to read all three books and pick one about which to make a presentation as part of the project. They were also invited to join asynchronous online discussions of these books.

There were several goals for the project. The first was to engage students in reading. Since this was a reading course, it would be helpful for students to keep reading both during and outside of class. When the books were recommended by the students themselves, it offered them more motivation to read. The second goal was to improve the students' ability to reproduce what they had read through a book report, practicing their language skills such as summary and their oral abilities to deliver what they had learned. The third goal was to develop students' critical thinking through reading, reporting, and discussion.

As part of a bigger research project, the data analyzed here focused on the book reports of *Would you Kill the Fat Man?* by David Edmund. This book discusses ethical dilemmas people may face and it is related to the topics of the textbook such as sympathy, justice, etc. Five participants chose this book to make their presentations. This study analyzed the oral and written productions related to this book to examine whether the participants expanded their knowledge through the project and whether it effectively promoted critical thinking at specific levels. Data sources include the PowerPoint slides for the presentations and book reports videos as well as related asynchronous online discussions. By using such data, the analysis draws conclusions based on the more objectively-produced data.

B. Analytical Framework: Bloom's Taxonomy

Bloom's Taxonomy was put forward in 1956 to outline levels of critical thinking. It helps educators to design lesson plans, curricula, courses, and classroom activities. It can also be used as a tool for formative and summative assessments of students learning. There are six major categories in the original taxonomy, ordered as follows: *Knowledge*, *Comprehension*, *Application*, *Analysis*, *Synthesis*, and *Evaluation* (Bloom et al., 1956). These stages imply an increase in terms of complexity from the more fundamental to higher levels of critical thought. It is often presented in the diagram of a pyramid, with knowledge as the foundation supporting subsequent levels of thinking.

Anderson and Krathwohl (2001) proposed a revised version of the taxonomy. In place of nouns describing the six levels of thinking, the revised version uses verbs and gerunds to describe the cognitive processes that learners are expected to master during the learning process. The revised six categories include: *Remembering*, *Understanding*, *Applying*, *Analyzing*, *Evaluating*, and *Creating*. We can see the parallels between these categories, particularly the first four since they are the verb forms of the corresponding nouns from the original taxonomy. Only the last two categories are somewhat different. *Synthesis* is the fifth level in the original and *Evaluation* is the highest level. In the revised version, *Evaluating* becomes the fifth level and *Creating* becomes the highest. According to the definition, *Creating* would combine elements into a pattern not clearly there before. This could be considered as the creative use of what one has learned from the other sources and thus is considered as the highest level. In this study, the revised version is used as the analytical framework to examine whether the reading report project could promote participants' critical thinking development.

III. FINDINGS AND DISCUSSION

A. Remembering and Understanding

According to the revised version of Bloom's Taxonomy (Anderson & Krathwohl, 2001), *Remembering* is the first level of thinking in which students are able to recall relevant knowledge from long-term memory. This level connotes a fact-oriented skill. For this project, the participants were not required to remember the facts discussed in the book. Actually, the book itself requires thinking from higher levels. In the online discussion, Student F was having an online discussion with two other participants; it is clear Student F may not have read the text very carefully or may have forgotten portions of what she had read:

Student F: This book reminds me of a real event in history. In the late World War II, US President Truman also suffered from the problem-whether to project an atomic bomb on Japan. If he does not project, the Allied forces will cost a lot to win the war, but projection will hurt many innocent Japanese civilians. In the end, as everyone knows, Truman chose to project an atomic bomb. Although Kant emphasizes that people are not means but ends, it is really not easy to achieve this goal in a real situation.

Student C: This case is also mentioned in the book. And later he was given BA (Hons) of Oxford University, which had also raised heated discussion in Britain and one of the philosophers (I remembered is Anscombe) was very against it. The case is also related to the trolley problem.

Student F in reply to Student C: They have lots of similarities and they are both painful. In situations like these, people cannot make decisions easily.

Student L: Yes, I remember that President Truman's degree got heat discussion. (Online discussion)

Here, Student F used the example of Truman, who ordered the atomic bombing of Japan, to illustrate its relevance to the trolley problem. Some people were against the proposal of Oxford offering him an honorary degree. The other two

participants here answered Student F's post by pointing out that this example is mentioned in the book. Using the word "remember," Student L confirmed that this honorary degree caused heated discussion. This is an example of *Remembering*.

According to the Taxonomy, *Understanding* is making sense of the material one has learned. For this reading report, the participants were required to introduce the book they had read, although there were no specific directions for how to make summaries. The participants had the freedom themselves to decide what to include to show their understanding of the book. Edmund's book discusses issues that are quite complicated because the author not only shows the ethical dilemmas that we might face, but he also presents the supporting evidence from different fields including philosophy, psychology, neuro sciences etc.

Each of the presenters introduced the book but with some variations. Some presenters showed a more detailed summary of what they read, while others highlighted key parts. For instance, Student A divided her presentation into four parts. In the general introduction, she made a summary of the whole book followed by a screenshot of the table of contents. She then introduced three classic cases from the book. After that, she discussed the main theories and their application. Finally, she concluded her presentation with her own thoughts. Her presentation summarized the book as follows:

The trolley problem was first used by a virtue ethicist to refute a hypothesis proposed by utilitarians and deontologists.

Utilitarians are based on the interests of the so-called majority, and presuppose that everyone has such a moral tendency that they naturally think that five people should be saved.

Deontologists presuppose that everyone has absolute moral orders in their hearts (such as absolutely not killing), and killing people for saving people cannot cover up the fact of killing. (Student A, PowerPoint slides)

Student A used three sentences here to summarize the main idea of the book. The first sentence introduced this famous thought experiment and the reason for its origin. It was put forward to refute the hypotheses by two other philosophical thoughts, one being Utilitarian and the other being Deontologist. She then used two other sentences to briefly introduce the meanings of these two philosophical branches, comparing and contrasting them. This is an example of understanding of the whole text.

Next, we will examine a more specific example from Student N who offered his understanding of an important concept in the book: Doctrine of Double Effect (DDE). After introducing the four premises of DDE, he said:

"...so these four premises may seem to be a little bit abstract, but think about another example, the United States military strikes terrorists bases but hurts civilians. So the act itself is not wrong and actually intends to good... to strike the terrorists bases you know, for peace and security but inevitably it would cause harm by hurting some of the civilians. But eventually, if you compare the good effects.. ur...after the terrorists bases were destroyed, we would have peace and security. Compare to the harmful effects, hurting some of the civilians, then the good brought is much larger than the harmful effects. So the DDE actually provides a solution to the ethical dilemma." (Student N, presentation transcript)

When Student N was introducing the concept of DDE, he used an example to illustrate the point after a brief paraphrase of the four premises of DDE. This provides evidence that he not only understood the meaning of the concept, but also was able to use his own example to further illustrate its meaning. Student N also used other resources to facilitate his understanding of the book. At the beginning of his presentation, he said: "This book ...in the field of what we call "ethics". Ethics is a sub-branch of philosophy, also known as the science of morality. ...and the first book on ethics is actually written by Aristotle, and the book name is this ..." (Presentation transcript). After giving a definition of ethics, he pointed to the front cover picture of a book and told the audience the book was written by Aristotle. It is a Chinese version of the book *Nicomachean Ethics*.

Several other participants also searched additional resources to better understand the reading materials. For example, several participants mentioned an open course by Michael J. Sandel, a professor at Harvard University, *Justice: What's the Right Thing to Do*, which used a number of cases related to the trolley problem for discussion. Student C and Student E offered the link in their presentations for their classmates. Student C also offered information of another book, *The Case of the Speluncean Explorers: Nine New Opinions*. From the link she provided, it was clear that she found a Chinese version of that book. Likewise, the English version of the book was offered to the participants by the instructor. However, some participants apparently found and read the Chinese version. In Student L's book report presentation, both Chinese and English versions were presented for some key parts. The participants demonstrated their efforts of using a variety of resources in both languages to facilitate the understanding of the text and it showed these efforts worked well.

B. Applying and Analyzing

According to the Taxonomy, *Applying* is using the knowledge gained in new ways and *Analyzing* is breaking the concept into parts and understanding how each part is related to another. In the following example, Student L made the following comments in her presentation when reflecting on the reading:

While reading this book, I related to what I read to what is happening in the world now. That is COVID-19. Since the outbreak of the COVID-19, some western countries have fallen into the dilemma like the trolley problem.

Some governments chose to sacrifice the elderly because of insufficient medical resources. There is no difference between sacrificing the fat man. Actually it is the contradiction of majority and interests. As to the interests, sacrificing the old men because when the people become old, they can't make more contributions to the society, and governments need to pay a lot of money to look after them. If using medical resources on younger people, the possibility for them to be cured is bigger, and in other aspects, ur, this way... can solve the problem of resources tension to some extent. But in moral aspect, this action hurts...infringe people's rights of life. That was the most basic right.

The presenter related what she read in the book to the real world. She read some news during the early COVID-19 outbreak in 2020 which reported dilemmas about how to allocate the limited medical resources in a coronavirus epicenter of northern Italy. Under such circumstances, some younger patients, with a higher possibility of survival, might be given priority. Doctors there had to make hard decisions of who could get medical care first when faced with limited health resources. She applied the ethical dilemmas discussed from her reading to the real world around her and analyzed the similarities of these scenarios with what discussed in the book. Beyond the oral presentation, she continued her analysis in the online discussion:

Student L: I think we are facing the same situation as the war. The epidemic is war without gunfire. Every country, every organization, every province, and every community is facing the trolley problem. Every decision is actually a choice between the interests of different people. For example, our country chooses to blockade Hu Bei province to protect the whole China and even the whole world. Some western countries have not yet to issue bans for going out. The problem is too complicated and the cultural traditions make it even more complicated. The trolley problem has been discussed for a long time from many perspectives. This shows that the ultimate choice still depends on one's own thinking.

Here in the online discussion, Student L shared her thoughts about the pandemic and compared it with a war. And she argued that decisions made by different countries were just like the trolley problem in that the interests of different people might be considered. She then furthered her analysis by pointing out that different cultural traditions might make it even more complicated. Here she did not just confine her analysis to the disparate interests of various groups but also take broader issues such as cultural factors into consideration. She not only understood the message in the original reading but she was able to apply it to new situations and continued her analysis to a higher and more complex thinking level. Besides the presenters, the other participants also shared their opinions or thoughts and offered some analysis based on their reading. For instance,

Student G: This book focuses on several philosophical problems, each of which seems so far from our daily lives that I would initially question why I need to be required to make such a choice. But in fact, these problems reflect the opposition between rationality and morality. Usually it seems reasonable to sacrifice the interests and even the lives of a few people for the interests of the majority, but this role like executioner will make people feel the torture of morality. After all, many things are a double-edged sword. This brings me to the thought of issue of cloning technology, which is obviously beneficial to the people who are alive now, but how to determine the legitimate rights of human cloning?

Student C: Yes. I think the trolleyology from one point of view is to think about the morality and rationality and offer suggestions on moral decisions. It is valuable to think and try to choose. I think with the development of technology there will be more and more moral debates and the trolleyology will not be out of date.

In this dialogue, Student G shared her first impression of the book, which she thought was initially not so relevant to reality. After reading the book, she gave her analysis and argued that the main issues of these ethical dilemmas were the conflicts of rationality and morality, or the interests of the majority and the minority. She then continued her argument with a new topic—the issue of cloning technology; this conversation was furthered by another student, Student C, who rightly pointed out that the development of technology might also bring more trolley problems and the discussion of this topic therefore is necessary and relevant in our lives. Here Student G was giving her analysis in relation to what she had read.

C. *Evaluating and Creating*

Evaluating means making judgement based on a set of principles while *Creating* means putting information together in an innovative way. These two are the highest on the thinking levels of Bloom's Taxonomy. We could say that the participants are also demonstrating thinking on these levels, particularly with *Evaluating*. For example, the online discussion of Student C:

Student C: In addition to my book report, I want to add more details about my thinking on the reactions of countries to the covid-19 which is similar to the trolley problem.

Earlier most of our Chinese praises highly on our government which actually is very excellent. And for a long time, I hold the belief that locking down is the only right choice we must to choose and all of other countries' choices are wrong.

But after reading the book and other's views, I find that we should not be so assertive. Take the British herd immunity for example. At first this solution was so unbelievable and puzzled for me and many people. But if we think from different views, with the unique characteristics of Britain, it will alarm them and make them not ignorant and then they will take actions to save themselves and it may be a good choice.

In conclusion, there is no absolute right or wrong. We should view things comprehensively and calmly and not comment one thing so assertively.

Besides her presentation, Student C also shared her thoughts in the online discussion by applying the trolley problem to whether to lock down cities during the COVID-19 outbreak. She shared in the online discussion how her attitude changed after she read the book. Before she read it, she thought there was only one right choice that could best solve the problem and all other choices were wrong. After reading the book and others' views, she started to realize that things might not be that simplistic. Many other factors could affect the decisions and different approaches might be preferred by different people. At the end, she said: "we should not be so assertive". Here is a very good example to show the thinking change process. Through this project, she developed a broader view of the divergent reactions people hold and started to think about things from multiple perspectives. Similarly, Student E also shared his thoughts:

Student E: In the book, the author gave us many variants of trolley problem. I admit there do exist some slight differences. But despite of such difference, whether you choose to turn the switch or to push the fat man, you will kill an innocent person, directly or indirectly. You will feel guilty the rest of your life although your aim is not to kill him but to save five people. Additionally, if we are not bystanders but the one of the five or the fat man, our choices are absolutely different. Sometimes I wonder why Western countries do not choose to lock down the infected city. I thought it will just sacrifice their freedom, but actually just like in Wuhan, maybe lockdown means that the healthy people will face the threaten of life. Now we are not people in Wuhan, we may not have such a deep feeling and we praise their sacrifice. Likewise, if we do not choose to push the fat man, why do we agree to lock down Wuhan. Because we are not those healthy people in Wuhan, we are not that fat man, instead we are the majority. I don't mean it is wrong to lock down Wuhan. I just think we all have a selfish nature and like Nietzsche said it is natural and healthy to be selfish. Also from another side, such selfishness can be said as to guard our right. For some policy makers, maybe they often face to such dilemma, no matter what decision they make, there is no clear standard between right and wrong. Finally, I think if the minority choose to sacrifice for the biggest benefit, it will be noble of them, but even if they don't want to sacrifice, we should not criticize them as selfish, because if we are the minority, we may not choose to sacrifice either.

In the first part of his discussion here, Student E gave his opinions about the different variants of trolley problems. He also offered his own judgment about what should be done and the possible consequences. After that, he started to talk about his thoughts about lockdown of Wuhan. Here he showed his ways of thinking in connection to the reading. He was able to think in a critical way when he questioned "Likewise, if we do not choose to push the fat man, why do we agree to lock down Wuhan?" He further explained his attitude towards the lockdown of the city and thought from the perspective of policy makers. At the end, again, he argued that the rights of minority should also be taken into consideration and their sacrifices should be appreciated. Furthermore, he added these people should not be criticized if they decided not sacrifice themselves. Here we could argue that indeed this participant demonstrated higher-order thinking.

Besides the presenters, the other participants who joined the discussion also showed their thinking about what is presented in the book. They thought about the trolley problem and offered their own understanding and evaluations of it. Two participants' online discussions are representative:

Student H: The aim of truly trolleyology is to provide principles that make sense of our powerful reactions and that can reveal something to us about the nature of our morality. I think trolleyology can remind us that we need to reflect more deeply on our own behavior and whether we can make a better choice in practical ethical problems.

Student J: I wouldn't like to kill the fat man to save the five skinny men either, unless the fat man intends to kill me at that time.

According to the several theories contained in this book, I think I am a utilitarian. When I am forced to choose between killing one or more, I will just consider the number, because that is simple. However, if I know the fat man is the president and the five skinny men are just old beggars, I will not make the decision too quickly. Apart from the number, I must consider more factors such as the social contribution, etc. Therefore, we can see that the more factors are involved, the more difficult the choice will become.

But if I must save those 5 people by pushing the fat man personally, I will give up, even the president is one of the five. That is not because I am kind enough, that is because I don't want to commit a murder just to save others who are unrelated directly with myself. Although there are different people in the world, I know the most will make the same choice as me. I think that is a nature of human beings, not just a matter of personality. Moral conflicts are everywhere in life. I don't think there is a solution that can satisfy everyone. In many cases, to make a choice is not to choose the right one, it is to avoid the worst one. In the same vein, the book is not aimed to tell us to do the "right things". The book is more closed to a reminder rather than a ruler.

The book reminds me that, if choices have been made, try to figure out how they were made, and whether we can give an answer that is more reasonable. If we need to make such choices, don't expect to satisfy everyone. We just need to think and to do and to not regret. If it is us who are bonded with the rail, we should know why we must be the sacrifice at least.

In her discussion of the book, Student H gave a very brief summary of the purpose of trolleyology. Then she gave her judgement about how we can use it in our daily life. After finishing the book, she thought it is necessary to examine our own behaviors and use it in our own lives to guide us when we are faced with ethical dilemmas. In comparison, Student J gave a more detailed discussion. First, she mentioned her answer to the title of the book: will you kill the fat man? It was no and she added a conditional clause, “unless the fat man intends to kill me at that time.” There is even a sense of humor here. Then she gave her detailed analysis by applying what she had read and claimed that she was a utilitarian, presenting the different decisions she might make in various scenarios. Student J also offered her reasons for her choices: “we can see that the more factors are involved, the more difficult the choice will become.” In the following, she went further by giving her judgment that there are always moral conflicts in our daily lives and there are no perfect solutions to these dilemmas. She shared, “In many cases, to make a choice is not to choose the right one, it is to avoid the worst one. In the same vein, the book is not aimed to tell us to do the ‘right things’. The book is more closed to a reminder rather than a ruler.” From her discussion, we see that Student J not only understood the text well, but she was also able to analyze and evaluate the whole issue precisely in her own language. In the last paragraph of her discussion, she pointed out that it was important to know what and how decisions were made and that decision-makers arrived at them with a clear sense. In spite of some minor grammatical mistakes in her writing, we do see Student J was able to think in the higher level of Bloom’s Taxonomy.

IV. CONCLUSION

Using Bloom’s Taxonomy as its analytical framework, this study examined whether PBL could engage students in critical thinking. The data analysis showed that the participants did demonstrate higher levels of thinking according to the terms defined by Bloom’s Taxonomy. The participants were not only able to read and understand the text, but they were also found to use multiple resources of their own choosing to help them better understand the reading materials. Besides, they were able to apply what they read and analyze the reading in connection with what happened around them. The participants also offered their evaluations of the readings and believed that they would be able to make better judgements in the future. Through this reading report project, the participants were found to integrate several skills together and conduct the project successfully. Besides using multiple resources to help them to understand the reading texts, they also learned to make online presentations by using relevant screen-recording software. The presentations gave the presenters opportunities to orally deliver what they had learned from this book to the class and the online discussion participation among all students further increased their understanding of the reading materials and promoted critical thinking development. Therefore, this study showed that PBL can be used as an effective approach to develop students’ critical skills as well as other skills such as reading, collaboration, and self-exploration. The study also found that although the participants demonstrated higher levels of thinking, they tended to focus more on the revised Bloom’s taxonomy levels of *Understanding*, *Applying*, and *Analyzing*. This may be related to the design of the project, which did not give explicit instructions about the proportion of higher level thinking and learning. In the future PBL design, it might be necessary for instructors to design the project to guide students to turn their focus more on the higher levels of the thinking ladder.

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