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Project-Based Learning of Agricultural Practices Based on Constructivism at International Schools in China

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Abstract: This paper explores the implementation of Project-Based Learning (PBL) in the teaching of Section 5.1 "Agricultural Practices" within the AP Human Geography course at an international high school. Grounded in constructivist theory, the study designates Period 5 as the experimental class and Period 2 as the control class. Since all students in the experimental class are minors, they participated in this PBL unit after providing informed assent with parental consent. The study was designed with three core objectives: (1) to assess students' understanding of four key agricultural practices; (2) to enhance students' acquisition of geography-related English vocabulary.The findings indicate that PBL effectively fostered student engagement, supported deeper conceptual understanding of the subject, and facilitated a shift toward student-centered teaching. However, the study's outcomes were notably constrained by students' limited English proficiency, insufficient time allocated for project presentations, as well as the short intervention period and small sample size. This research underscores both the potential and contextual challenges of applying PBL in Advanced Placement (AP) courses—settings characterized by linguistic diversity and dense academic content.

Keywords: Project-Based Learning; AP Human Geography; International school

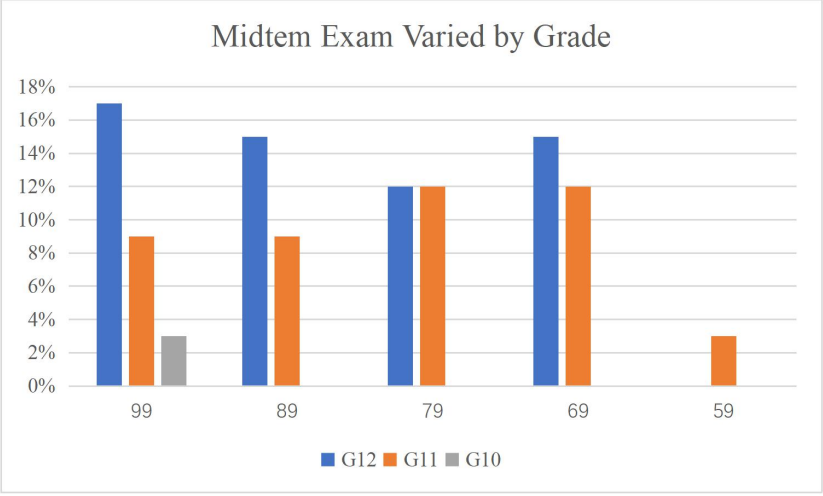
1. Introduction

Geography is a subject focused on broad topics, especially in understanding the interaction of humans with the environment in high school. (Arisanty, D., Hastuti, K.P., Setiawan, F.A., & Imawwati, R. 2020). Geographical skills, like spatial relationships and scale analysis are among the most challenging aspects of the AP Human Geography course for many students at international high schools in China that implement the Advanced Placement curriculum system. In this curriculum, AP Human Geography is typically an elective course, so students can select it according to their interests and the popularity of the respective teacher. In this school context, students demonstrate diversity in age, gender, English profiency, personality, and foundational knowledge in other subjects.

The situation is the same an international school in Shenzhen, which is located in south China. Shenzhen is a metropolitan city with the third largest GDP in China. In 2024, there were three AP Human geography class sections, Period 2 (P2), Period 4 (P4), and Period 5 (P5) with a total of 34 students. P2 consisted of 6 students from twelfth grade (G12) and 7 students from G11; P4 had 1 student from G10, 2 students from G11, and 9 students from G12; P5 included 4 students from

G12 and 5 students from G11. All of these students are from China and are studying English as an additional language (EAL).

The AP Human Geography midterm exam for my course was 80 minutes long and made up of 40 multiple-choice questions and two free-response questions. There was a conspicuous discrepancy in test results along class sections and grade division. As for the classes, P4 had the highest average score at 87 out of 100, followed by P2 at 84.72, and P5 at 74. In terms of grade level, G10 had the highest average score with 99, followed by G12 at 85.6, and G11 at 78.5. However, G10 only had a small sample size of one student.



Graph 1: The AP Human Geography Midterm Exam Varied by Grade.

After the midterm exam, the teaching topic of AP Human Geography changed from population to agriculture. Compared to the population chapter, the agriculture chapter focused more on physical geography and rural landscape. The typical pedagogical approach made it challenging for students who have lived in urban areas for most of their lives to understand crop selection, different agricultural distribution practices, and their impacts on the environment. In addition, in terms of the teaching model of the school, the classroom experience often remains confined to on-campus activities. In the limited space of the campus, fully understanding the geographical phenomena of daily life was very difficult for students. This led to many geographical knowledge points being hard to understand, as the information was only conveyed through teachers' oral explanations and PowerPoint (PPT) presentations in class. As a result, the acquisition of geographical knowledge has become teacher-centered, with students only passively absorbing it, lacking active acquisition and the construction of knowledge.

To address this challenge and make full use of the resources of the city the students are living in, Class P5 was selected for Scheme Of Work, with the teaching content being 5.1 Agricultural Practices in AP Human Geography.Before the implementation of this teaching practice, since some of the high school students were minors, they were informed by email to voluntarily participate in the classroom teaching practice. The data used were anonymized, and participants could withdraw from the research at any time. The research data was only used for the study, and all students and parents agreed. I tried using project-based learning (PBL), an approach initially introduced by Kilpatrick and further developed by Blumenfeld et al. (Kilpatrick, W., 1921; Blumenfeld, P., Soloway, E., Marx, R., et al. 1991), to achieve the following goals: measure the understanding of the knowledge in the 4 agricultural practices of AP Human Geography; measure the increase in geography-related English vocabulary knowledge; and the application of inclusive practices into PBL effectively.

2. Justification for Planning and Literature Review

2.1. Discussion Constructivist Theory

In order to better design class activities and complete the scheme of work, I followed constructivism theory as a guiding principle. In 1937, Jean Piaget proposed

that children construct knowledge through interaction with the environment, emphasizing that learning is an active process. When constructivism is applied to learning, scholars point out that it advocates that students will interpret and internalize new knowledge according to their existing understanding framework in their learning process (Applefield et al. 2000). When applying constructivism theory to teaching, teachers help students construct theoretical knowledge intentionally by proactively creating suitable classroom environments and designing classroom activities (Yilmaz, K. 2011). How do we create an appropriate class atmosphere to promote students' knowledge construction? Educators have put forward a variety of teaching principles, such as posing relevant questions according to the fundamental knowledge concepts, listening to students' views equally, respecting students' assumptions, adjusting teaching designs, and assessing students on course knowledge.

Implementing constructivism theory in the class has the advantages of triggering students' subjective initiatives and forming a student-centered classroom. When students' enthusiasm is stimulated, it is possible for students to experience the joy of success, boost the pleasure of solving problems, increase the sense of achievement, and form a virtuous circle (Karagiorgi, Y. and Symeou, L. 2005). In a study of 25 ninth grade students taking a physics course in the United States as an example, teachers used constructivism to explain the knowledge of series and parallel circuits. This included the students building series and parallel circuits by themselves using wires. It is concluded that in a constructivist classroom, teachers are not the only source of information, and students need to communicate with each other. During classroom interaction, students do not listen passively but instead participate actively, allowing them ample time to adapt (Applefield et al. 2000). Another example of constructivism education occurred in a study based on physical geography education. Based on students' challenges in understanding and mastering the concepts of physical geography, Daviran, E. (2024) designed a constructivism framework, which includes three stages: cognitive scheme, assimilation, and accomodation.

Although a constructivist learning environment can enhance students' participation and increase their problem-solving and cooperation abilities, there are also challenges when implementing constructivism in teaching practice, such as time management, teacher role, assessment difficulties, and students' cognition abilities. In terms of time management, constructivist methods require more time to complete each topic, but if possible, provides enough time for students to assimilate and construct knowledge in the implementation process. In addition, due to the fact that the instruction designer's access to individual learners' cognitions is extremely indirect and limited (Wilson, 1997), it is difficult to determine the evaluation criteria for the teaching design. In a constructivist framework, teachers usually act as facilitators, guiding students through the learning process (Lee, 2007). Because of the diversity of evaluation criteria, the teaching effect of constructivist classrooms cannot be quantified. Another key challenge of constructivism is that many teachers continue to be influenced by traditional teaching methods. Reliance on conventional approaches can hinder the effective implementation of constructivist principles, preventing educators from fully engaging in student-centered learning practices.

In conclusion, Even though constructivism is affected by factors such as time, teachers' understanding, assessment, and students' abilities during its implementation, nonethelessthe, constructivist approach provides numerous benefits in geography education, enhancing both student engagement and understanding and fostering a supportive learning environment with varied activities and teacher facilitation.

2.2. Discussion Project-Based Learning (PBL) Theory

Although constructivism provides a good guide for teaching, it still lacks a clear implementation path in practical application. According to a literature review about constructivism, "Modern constructivism provides the theoretical basis for project-based learning" (Applefield et al. 2000). Therefore, I decided to adopt the project-based learning strategy based on constructivism in my pedagogical strategy.

Project-based learning (PBL) is an instructional approach that engages students in tackling complex tasks through challenging questions or problems, emphasizing student-centered learning processes. Project-based learning is easy to confuse with Problem-Based Learning. Compared with Problem-Based Learning, PBL is more widely applicable and focuses on connecting knowledge with reality, regardless

of whether it is a problem or not. PBL is generally separated into four stages: proposal, processing, display, and evaluation of a project. However, some scholars put forward five stages instead: theme selection, project planning, information collection, information completion, and display and evaluation (Gai Mali, Y. C, 2016). There are also scholars who propose six stages: formulating a fundamental question, collaboratively planning projects, scheduling, monitoring student activities, presenting project results, and conducting evaluations. This process promotes active learning, fosters creativity, and conducts self-assessment among students. It can also improve their comprehension and social skills (Arisanty, D., Hastuti, k.p., Setiawan, f.a., & Imawwati, R. 2020). In short, the models of PBL strategy are diverse.

Project-Based Learning can foster students' skills, such as critical thinking, problem-solving, and knowledge construction (Bell, 2010; Dewi, 2018). PBL also allows students to explore new fields, identify scientific problems, and integrate knowledge across subjects (Dewi, 2018). In geography education, a plethora of studies suggest that PBL helps to promote teaching and improve students' geographical knowledge. In a physical geography classroom in Indonesia, teachers encouraged students to actively gather information from a variety of sources in small groups and label it on a map. The project deepened students' understanding of Indonesia's mineral resource spatial concept. This approach is particularly beneficial for visual learners, while simultaneously teaching valuable skills in time management and teamwork, promoting a more dynamic learning environment (Sarwono, A. Sugiharto, 2015). A study in the United States demonstrated that students in grades 7-8 who participated in science PBL showed better comprehension skills and achieved higher pass rates on statewide tests (Geier et al. 2008). Additionally, Project-based learning can promote a more inclusive classroom. PBL provides an inclusive classroom that helps students with disabilities advance in creative expression and critical literacy skills by promoting positive interaction and collaboration between them and their peers. For example, in a study involving an inclusive English language arts class, students with disabilities and students without disabilities classmates participated in projects and shared their perspectives, thereby enhancing each other's understanding of the world and their sense of learning options (Boardman, A.G. and Hovland, J.B. 2022).

However, scholars also summarized some challenges in implementing project-based teaching, such as teachers' inexperience, time arrangement, practicing process, evaluation methods, or lack of student cooperation (Raath & Golightly, 2016). The time-intensive nature of PBL can disrupt other academic schedules and lead to class management issues. In addition, students may prefer working individually due to conflicts within groups, such as some members being unmotivated or dominating. Because PBL requires teams to work together, it is difficult to ensure that each team member contributes equally to the task throughout the project implementation process. Another challenge for PBL is how to balance excessive teacher control and a lack of teacher feedback and guidance for project completion (Dooly & Masats, 2008). Finally, external factors such as teachers' inexperience with the model, students' unfamiliarity with the approach, and associated project costs can hinder the successful implementation of PBL (Arisanty et al., 2020).

2.3. How to Design PBL under the Guidance of Constructivist Learning Method

Through the literature review, it can be claimed that PBL has its theoretical basis under the guidance of constructivism. Although the case studies on both sides of the support spectrum are very rich, PBL practice guided by constructivism is still very rare. Therefore, it is meaningful to execute PBL teaching practices in AP Human Geography classes across international high schools as it can provide more research cases for PBL. However when designing PBL, teachers need to pay attention to some misconceptions. Firstly, some teachers think constructivism learning theory focuses only on the process and not the outcome. In fact, constructivism values both the process and the result of learning. It emphasizes deep understanding through meaningful experiences, rather than simply memorizing facts or rules (Applefield et al., 2000). The second common misunderstanding is that PBL equates to leaving students to their own devices. Some teachers believe that PBL is about allowing students explore freely without teacher guidance, while others believe PBL involves rejecting all traditional methods of teaching and is only about students doing projects, both

of which are misunderstandings (Wolk, S. 2022). Even when students encounter obstacles in task allocation or group communication and collaboration, teachers still mistakenly encourage students to solve these problems by themselves. This phenomenon results from the long duration required for PBL implementation. In practice, however, effective PBL requires teachers to carefully design tasks, set clear goals, and provide timely support and feedback (Farhan, F.I. and Ardimansyah, A.2023).

Based on the summary of the literature review above, the scheme of work was committed to using constructivist learning methods to design courses on regional agricultural. In this study, P5 was the experimental group with PBL teaching, and P2 was the control group with regular teaching. After finishing the teaching process in the two classes, the same exercises were used to check whether PBL teaching could improve the students' performances in tests on agricultural practices.

The Project-Based Learning (PBL) design in the scheme of work for P5 had three stages: cognitive schemes, assimilation, and accommodation (Daviran, E., 2024). In each stage, there were specific requirements, and I outlined the roles of the students and me. In the cognitive schemes stage, I explained the PBL requirements for the students. They would work in pairs and choose one type of agricultural practice. Then, they needed to visit a supermarket to find 7 types of products produced from their chosen agricultural practice from China and 3 types from other countries and mark the origins of these products on a world map. In the assimilation stage, students would analyze the distribution of the agricultural products and discuss what geographical features were shown and what factors influenced the location of the products. Next, they would look up relevant information and create a PowerPoint presentation for their report. In the accommodation stage, each group would present their findings. Through this, the students learned about different types of agricultural practices and how geographical regions affected the environment. Tasting of the food was available after each group presentation as a bonus.

When designing PBL, teachers should work to avoid problems such as unclear evaluation during the implementation of PBL and low student participation during group presentations (Farhan, F.I. and Ardimansyah, A.2023). The following activities were specifically designed to help my PBL proceed smoothly. I provided a rubric for students before implementation, which included aspects of content, team cooperation, presentation, and English vocabulary. During the process of group presentation, I supported the PBL design (**Table 1**) as a tool to help students take notes, summarize information, and refine their knowledge on agricultural practices. After the group presentations, the students gave feedback, and I provided corresponding questions, such as multiple choice questions, free response questions, and vocabulary questions to test the students' learning effect.

Table 1. PBL Design with Teacher and Student Roles

Constructivism	Project Based Learning "4 agricultural practice characteristics and distribution"	Teacher's role	Students' roles
Cognitive Schemes	How do food items connect to crops and animals? Label at least 7 local food locations and 3 foreign food locations on the world map. Why can the same type of food be found in different locations in the world? Create a food locations map.	Group students so that each group has a diverse combination of grade levels and gender types.	Students were divided into groups. Group discussions determine the type of agricultural area chosen. Schedule the time and location for group supermarket visit.
Assimilation	Group presentations and food sharing afterwards.	Evaluate each group in terms of time. management, content, cooperation. Provide the multiple choice questions	Each group researches the location characteristics for agricultural practices and the impacts when implementing those agricultural practices from economy, social, political aspects. Each group creates a PPT to present.
Accommodation	Why are these foods available in Shenzhen supermarkets?	Connect to the future concepts like commodity chains.	Taste foods and complete notetaking. Practice the questions in class.

3. Analysis

3.1. Reflective Analysis of the SOW in Context of Teaching and Learning

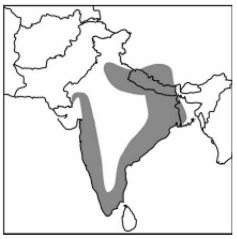
Through a practical analysis of my course, I found that students in the experimental class P5, which experienced Project-Based Learning, and the control class P2, which experienced regular learning, achieved different learning goals. For the multiple-choice questions given in the lesson practice the end of the course, the scores of the two classes were nearly equal. However, for the free-response questions, the PBL experimental class P5 performed better overall, and the achievement gap within the class was smaller than that of the control class, although the high-scoring students in the control group still performed well.

The first type of question on the practice was multiple-choice, with two of them shown in **Graph 2**. All the students in P5 were correct, while 8% of the students in P2 were incorrect because of mixing up wet rice with plantation farming.

Table 2. The Accuracy of Questions for Students in P5 and P2

Group	Student Number	Multiple Choices Questions	Free Response Question
Experimental Class -P5	9	100%	67%
Control Class-P2	13	92%	62%

Q1:
On the map above, the shaded area is most associated with which of the following types of agriculture?



A) Truck farming
(B) Plantation agriculture
(C) Slash-and-burn cultivation
(D) Rice cultivation
(E) Dairy farming

Q2:
A food assemblage that includes olives, pita bread, cheese, figs, lamb, and wine is most associated with which of the following?
(A) Spain
(B) Greece
(C) Mexico
(D) France
(E) Russia

Graph 2: Multiple Choices Question

Graph 3 displays the second type of question, which is free-response. 67% of students from P5 correctly identified tropical regions in their answer, while only 62% of students from P2 did so. Others incorrectly mentioned proximity to the equator or developing countries.

Free response question

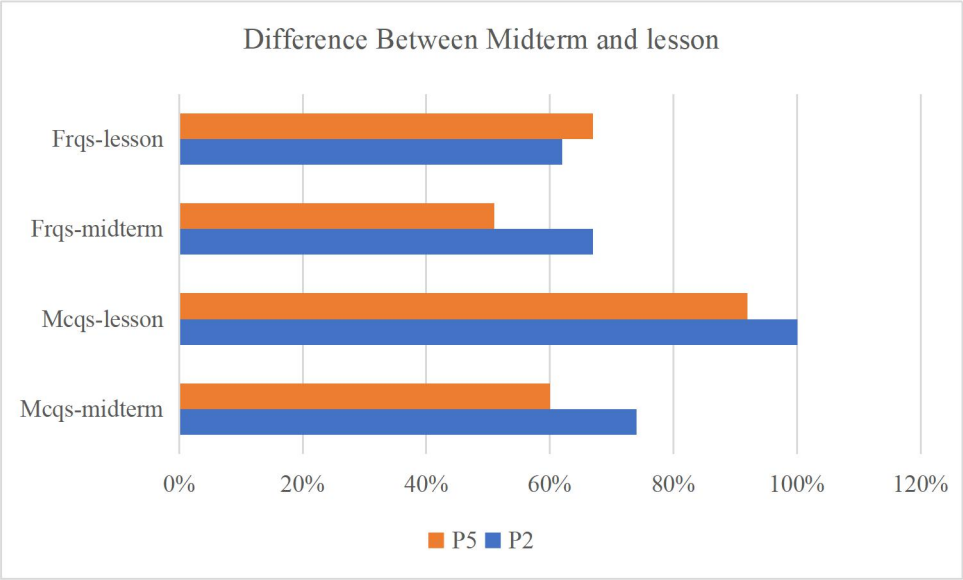
Agricultural systems, such as the production of coffee, are part of a global network.

A. Describe a common characteristic shared by the coffee producing countries shown on the map.

B. Explain two impacts of coffee farming on producing countries.

Graph 3: Free Response Question

Compared with midterm exam results, both classes improved their performance in multiple choice questions in the end-of-course lesson practice. However, the improvement increase of the experimental class P5 exceeded that of the control class P2 (**Graph 4**). For free-response questions, the accuracy of P5 in the experimental group improved significantly, from 51% to 67%, while the control group demonstrated a 5% decline. This comparison suggests the effectiveness of project-based learning (PBL) in enhancing students' comprehension and question-response skills.



Graph 4: Difference Between Midterm Exam and Lesson Practices

3.2. Promoting Inclusiveness for EAL Students in PBL

Although no data on the frequency of English usage by students in the P5 class was collected in this teaching session, Classroom observed suggest that students in the P5 class who participated in the project-based learning (PBL) in agriculture, used geographical-related English vocabulary (such as transhumance, livestock ranching) in class with a significantly higher frequency and greater confidence level than students in the P2 class who adopted the traditional lecture method. Since project-based learning (PBL) requires students to present, each group in P5 had 15 minutes to present the agricultural practices they learned about. This provided students with more opportunities to practice their oral English and speak English more frequently. In addition, the interaction frequency beteen students in the experimental class was higher than that of the control class, mainly reflected in two areas. Firstly, if the listening students had questions during note taking, they would initiate consultation with the reporting group. Secondly, during the food tasting activity at the end, students actively exchanged their experiences and thoughts on this project.

Nonetheless, during the design and implementation of project-based learning (PBL) for experimental group P5, the students and I encountered some challenges. One such challenge was the difficulty for students to find products of certain agricultural practices in supermarkets, even in a relatively cosmopolitan city like Shenzhen. For example, in horticulture, most of the available flowers are from China, and students were unable to find three types of foreign flowers. This situation not only limited the scope of their research but also affected the overall presentation of the project. Regarding location map making, there were two groups with different chosen agricultural practices but had similar maps, which showed that the students did not accurately understand the difference between the two agricultural practices. Although the PBL project was clearly targeted, students often struggled to express their opinions effectively, resulting in a lack of creativity and personality in their final work. I also offered insufficient support to the students when

guiding them, leading to inaccurate data collection while exploring the geographical types of agriculture. During the presentation, some students proposed questions on the differences between livestock ranching groups and pastoral nomadism groups. However, after the discussion, the presenters did not provide a clear explanation of their presentation topic. It illustrated students' shortcomings in integrating knowledge and expressive communication, exposing the limitations of their information gathering, which is insufficient in depth.

4. Conclusions

4.1. Discuss the Successes of PBL under the Guidance of Constructivism

By designing and implementing PBL in class P5, I carried out the teaching of topics on agriculture practice. In addition to the progress mentioned earlier, Class P5 also demonstrated outstanding improvement in the contribution to an effective class learning atmosphere, depth of knowledge, and problem-solving. This corroborates with the idea of how "students learn from the experience of doing projects together in the classroom and out in the real world" (Wolk, S. 2022).

Concerning the classroom atmosphere, the classroom had shifted from a traditional class model (teacher-centered) to a student-centered model, from raw knowledge absorption to the active construction of knowledge. This transformation fostered a more positive and collaborative classroom culture where students were encouraged to actively participate and share their ideas. A positive classroom climate makes students feel welcome, respected, and valued, in contrast to a negative climate that can feel hostile, chilly, or chaotic (Brame, 2019). Specifically, I observed that students in the class that adopted PBL asked more questions than those in classes that did not. In addition, the groups that focused specifically on dairy farming and intensive wet rice cultivation demonstrated their deep understanding of these topics. The students performed deep research, which was evident in their presentations. The dairy group chose to research different brands of milk and locations of production. In the map, dairy production is clustered in the middle of Europe while it is dispersed in China. While doing the group presentation, the presenting students designed a question to trigger the audience, which was why dairy production in China showed dispersed distributions. Then the group explained the reasons, with one being how high consumption ability attracts more producers and the other being how diverse climate distribution conditions provide opportunities for developing dairy agriculture. The ideal climate for dairy production is where there is sufficient rainfall and moderate temperature. Milk is a part of many students' diets, so offering the reasons for dairy distributions was more intuitive for them. Another discussion involved "Chenguang," a famous brand in Shenzhen, and "Telunsu," a popular brand in China due to advertisement. Telunsu is located in the golden milkshed region of China, while Chenguang, with a short preservation time, is located in Shenzhen. The students came to a general consensus after deliberating the reasons behind this difference. Fresh milk like Chenguang is easy to spoil, so it must be close to Shenzhen. On the other hand, the golden milk shed is located at 43 degrees north, far away from cities with huge markets. Thus, the preservation time must be longer in order to earn more profit. Finally, the inclusive approach adopted throughout PBL was also of great use in developing students' civics, social responsibility, critical-thinking skills, and collaboration skills (Wolk, S. 2022).

4.2. Discuss the Shortcomings of PBL

My PBL involved the teaching of how the markets of agricultural products are related to natural geography, climate, and human factors. Moreover, the project provided a preliminary foundation for the follow-up chapter, which was hearth and commodity chains.

Firstly, language barriers limited students' mastery of relevant English vocabulary. Due to the design of PBL and data collection of agricultural product origins, which were all in China, students used Chinese for observation and summary. I only required students use English during presentations, and the evaluation criteria of my PBL did not clearly specify requirements in English vocabulary, which resulted in poorer English abilities of the students.

Secondly, inadequate time for presentation led to insufficient communication. Due to the overall class duration, each group was limited to only 15 minutes for presentation, which did not meet the needs of all groups. The group on livestock ranching conducted in-

depth analyses of the selected agricultural types, but due to time constraints, they only briefly mentioned the relevant environmental impacts, which the other students failed to understand. This was also a disadvantage of project-based teaching (PBL), as time-constrained schedules prevented students from deeply understanding the important content.

Thirdly, The sample size is relatively small and the time period is short. Due to being an international school, the small class size has limited the number of students participating in this PBL practice. Moreover, the PBL teaching practice is centered around the theme of agriculture and has a short duration.

4.3. Future Outlook

It is essential to increase students' English vocabulary in order to enhance their language literacy. Project-based learning is not just about having students engage in practical projects but also involves learning new knowledge and skills that require competent English abilities. This is especially true when it comes to reading and writing, which is required by almost every project (Wolk, S. 2022). Considering the high dependence of the AP Human Geography course on English vocabulary, vocabulary training for specialized terms and core concepts should be added to the PBL design. For example, relevant vocabulary can be previewed before each project. Additionally, students' understanding and application of technical terms can be improved through various methods, such as vocabulary lists, games, or group discussions. English materials and illustrations can also be introduced so that students can better bridge the gap of the concepts and knowledge between Chinese and English.

Lastly, I plan to enrich the evaluation of PBL. "PBL has more authentic, student-centered, and holistic assessment. Assessment is not just done at the end of the project or unit but is an inherent part of teaching every day" (Wolk, S. 2022). In addition to regular evaluation, reasonable group discussions and regular reflective discussions have a positive effect on teachers to support the active participation of all students (Sormunen, K., Juuti, K. and Lavonen, J. 2020).

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