

A Critical Review on Project-Based Learning in Japanese Secondary Education

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日本の中等教育段階における探究学習の現状と課題

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Project-based learning (PBL) implementation in Japanese secondary school education has more momentum than ever before. However, PBL implementation in high schools is very limited. The purpose of this paper is to critically review the early stages of PBL implementation in Japanese secondary school education, which is currently in the process of significant reform. Why is PBL receiving so much focus in the reforms being made in the Japanese secondary school education now? What kinds of practices are schools following that explain the challenges facing secondary schools in implementing PBL? PBL in Japan has been implemented in a move towards experiential education since the early 20th century in correlation with two compatible approaches; systematic education and experiential education. The current challenge of PBL in secondary schools is to actualize PBL practices in schools through innovating the mindset of schools and teachers to move from systematic education to experiential education under the pressure of primary and secondary school curriculum reform and high school and university articulation reform. To make the PBL approach more effective in schools, setting a driving question based in the real world is effective. In that sense, PBL based on community revitalization and sustainability are powerful. In order to examine the context and effect of PBL in detail, we refer to how PBL has been implemented in schools with the encouragement of the Japan Innovative Schools Network (ISN), supported by the OECD. Global collaboration has a powerful effect on Japanese secondary school students. This paper intends to contribute to global educational reform efforts, since education reform is a major concern for every country.

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1. Introduction

A new movement to promote inquiry-based learning focused around projects is gaining traction in Japanese secondary school education. This promising approach is known as Project-based learning (PBL). Two years ago, *Chuo Kyoiku Shingikai*, the Central Council for Education in the Ministry of Education, Culture, Sports, Science, and Technology (MEXT) submitted a report on school curricula from kindergarten to upper secondary schools that highlighted “Proactive, Interactive, and Deep Learning” as a new style of active learning education to address rapid-social change in a knowledge-based society in 2030 and beyond. To achieve this new style of education in the classroom, PBL is considered vital and

its implementation has been the focus of much recent discussion. Implementing PBL in high school education is especially in demand recently, but so far there hasn't been substantial progress towards its implementation in the classroom¹⁾²⁾.

The purpose of this paper is to critically review the early stages of PBL implementation in Japanese secondary school education, which is currently in the process of significant reform. There has been research into PBL and attempts at PBL implementation since the last century, so why is PBL receiving so much focus in the reforms being made in the Japanese secondary school education now? What kinds of practices are schools following that explain the challenges secondary schools face in implementing PBL?

It's important first to give the historical background of PBL and explain the defining features of PBL. First, we will classify Japanese PBL application in schools into two historical lineages and two current social contexts. Then, we will classify PBL application in Japanese secondary schools and the challenges that have arisen. In order to examine the context and effect of PBL in detail, we will refer to how PBL has been implemented in schools with the encouragement of the Japan Innovative Schools Network (ISN), supported by the OECD. The OECD has led a global movement towards education reform for 2030, and their research has been referenced by the Center Council for Education. A discussion on the implementation of PBL in secondary schools will follow since secondary schools are a crucial time and space for students to shape themselves and become responsible members of society.

2. Historical Background and Defining Features of Types of PBL

A. Two Types of PBL: Problem-based learning and project-based learning

There are two types of PBL that are recognized as effective in facilitating learning outcomes. One is project-based learning and the other is problem-based learning. Both types of PBL have similar characteristics and share a common root, and there is also a tendency to include problem-based learning as a part of project-based learning³⁾. We will use PBL in this paper to mean both types of PBL unless otherwise stated. In the next section, we will describe the features of project-based learning by tracing

the historical and philosophical background of the two types of PBL.

Thomas⁴⁾ stated simply that "(p)roject-based learning (PBL) is a model that organizes learning around projects". Multiple definitions have been given for PBL, and there isn't a universally accepted model even after ten years of PBL application. Each research defines PBL in its own way, but it is defined inclusively³⁾⁴⁾⁵⁾.

According to Thomas⁴⁾, there are five criteria for PBL: centrality, a driving question, constructive investigations, autonomy, and realism: 1) "PBL projects are central, not peripheral to the curriculum;" 2) "PBL projects are focused on questions or problems that "drive" students to encounter (and struggle with) the central concepts and principles of a discipline;" 3) "Projects involve students in a constructive investigation;" 4) "Projects are student-driven to some significant degree;" and 5) "Projects are realistic, not school-like."

Historically, this learner-centered and inquiry-based style can trace back its philosophical origin to John Dewey's work in experiential education. If the learners encounter real and meaningful tasks and problems, they will engage themselves with the material. Research into science education developed and refined Dewey's insight on active inquiry resulting in a deeper understanding⁶⁾. In his book, "How we think," Dewey⁷⁾ pointed out five steps: (i) a felt difficulty; (ii) its location and definition; (iii) suggestion of a possible solution; (iv) development by reasoning of the bearings of the suggestion; and (v) further observation and experimentation leading to its acceptance or rejection. Dewey believed that this process of thinking itself was learning, and Kilpatrick succeeded Dewey's ideas of learning and developed an instructional approach, called the Project Method which is recognized as the origin of project-based learning³⁾. The other type of PBL, problem-based learning, evolved from medical education in the late 1960s, based on Dewey's problem-solving strategies situated in the real world. Both types of PBL are recognized as similar and promising approaches for preparing students to face social and global problems caused by the rapid social change of this century. However, each type of PBL is structured based on the context of their implementation. Therefore, it's important to describe the origin and implementation of both types of PBL.

1. Problem-Based Learning

Problem-based learning began in medical education at McMaster University in the 1960s. More than 80% of American medical schools have implemented the method in addition to two-thirds of Japanese medical schools as of 2004³⁾. In the United States, it spread to other disciplines, for example, law and engineering and then into science education in primary and secondary schools. In Japan, it is actively being implemented. Takeo and Majumdar⁸⁾, an expert on PBL in McMaster University, published a textbook together while implementing it into primary and secondary schools in several subjects.

Problem-based learning, with its roots in medical education, evolved to fill a significant gap between classroom study and real-life medical practice. Even though students could pass medical license examinations after intensive lectures and a clinical teaching program, it was often the case that newly licensed doctors faced problems and could not adapt to real-life situations. Moreover, “(m)edical educationwas rapidly becoming an ineffective and inhumane way to prepare students, given the explosion in medical information and new technology and the rapidly changing demands of future practice”⁵⁾. Forty years later, it is not only medical education that is rapidly changing, and problem-based learning is applied in various types of education globally.

The purpose of problem-based learning is to solve a problem set in reality. Firstly, students are provided with the problem and are asked to identify what is wrong with the patient. With their knowledge and the given facts, they generate hypotheses and identify knowledge gaps between what they know and what they need to know to diagnose the patient. This process results in them engaging in self-directed learning. After applying newly acquired knowledge to the problem and evaluating, a final decision can be made on the diagnosis and patient management. Finally, they reflect on what they learned. This cycle of learning recalls Dewey's five steps.

Woods⁹⁾ points out the difference between PBL and traditional instruction as the moment when a question is presented and the purpose of questioning. During PBL, a question is asked at the beginning to evaluate one's own level of knowledge and determine if the question can be answered, while in the traditional classroom, the question is asked with the intention of using what has already

been learned. Learning is achieved through this series of processes called the PBL tutorial cycle. Teachers facilitate students learning through this cycle, and this in turn promotes self-evaluation of knowledge levels to determine what students still need to find out.

Bridges and Hmelo-Silver¹⁰⁾ summarized research on the effectiveness of problem-based learning. Most assessment has been conducted on knowledge structure and metacognitive skills. Comparing problem-based learning and lecture-based instruction has verified that the metacognitive skills of students in PBL programs were clearly higher than those of students not in PBL programs. Planning and monitoring skills are expected to be promoted. Problem-based learning students have a positive attitude towards the approach and find it more engaging and useful, as well as more difficult. Since problem-based learning supports the development of reasoning, problem solving and decision making, it should be researched more fully in the future.

2. Project-based learning

Project-based learning is organized around a real and meaningful project, similar to the problem-based learning but often in a much larger scale. Students start with what is called a driving question that “drives” students to encounter the theme of what they will learn and to answer through inquiry. Krajcik and Shin⁶⁾ verified six key characteristics of effective project-based learning based on designing, developing, and assessing curriculum materials of science and technology in partnership with teachers: 1) driving questions guide instruction; 2) focus on learning districts and states goals with confidence; 3) engage in actual scientific practice; 4) collaborate with students, teachers, and members of society to investigate questions and ideas; 5) use technology to support learning by enhancing engagement in scientific practice and collaboration with students, teachers, and members of society; and 6) create artifacts to motivate students and represent their newly acquired knowledge. It sounds strange that the curriculum designers have to focus on learning districts and states goals because PBL should be based on learners' question in a real world. However, in the United States, standards were carefully framed to be compatible with high-level and creative learning that apply PBL⁶⁾. This endeavour presented a new vision for organizing discipline-centered

and systematic knowledge and life experience¹¹⁾.

Krajcik and Shin⁶⁾ emphasize the importance of developing learning goals with driving questions and supporting teachers with concrete strategies. Recognizing project-based learning as a style of situated learning, they further explain the meaning of selecting driving questions because “the most effective learning occurs when the learning situated in an authentic, real-world context”. Driving questions should be “worthwhile” so that rich content meets learning goals and matches what scientists really do, “contextualized” so that they are anchored in the real world as significant and important, and “meaningful” enough to interest and excite learners to motivate them to learn. Predicted learning outcomes include increased attendance, developed sense of independence, improved attitudes towards learning, high-level thinking skills, problem-solving skills, collaborative skills, and improved communication skills³⁾.

3. PBL in Japan: Two Lineages and Two Vectors Based on Current Social Contexts

A. The Two Lineages: Grassroots curriculum and the Courses of Study

PBL was implemented in Japan in a move towards experiential education in the early 20th century. Since 1947, Japanese school curricula, from kindergarten to upper secondary schools, have been required to meet the standards, *Gakushu Shido Yoryo* (the Courses of Study) authorized by the MEXT¹²⁾. After World War II, grassroots efforts at curriculum reform and the Courses of Study took shape in correlation with the two compatible approaches; systematic education and experiential education, and to the extent of one approach overcoming the other¹¹⁾. The experiential approach of “connecting education with life” before the war was revived under the American progressive influence after the war. However, a decline in student achievement gave rise to criticism of this approach and led to a shift towards discipline-centered systematic education in the 1960s.

On the other hand, dropout rates gained attention in the 1970s and a new inquiry into the value of a student-centered curriculum was launched. In 1998, the government introduced a new curriculum that reduced the amount of educational content in the curriculum and cut the number

of lesson hours in addition to implementing *Sogotekina gakushu no jikan* (Hour of Integrated Studies) which promoted experiential education. This led to an increase in the development of PBL curricula, especially interdisciplinary PBL and regional PBL.

Nonetheless, OECD-PISA results around that time showed Japan fell in the rankings more than any other country. The results opened a dispute about a decline in achievement and once more led to criticisms of experientialism. More reform was needed to improve student achievement. MEXT revised the Courses of Study in 2007 for elementary and lower secondary schools, and in 2008 for upper secondary schools and schools for students with special needs¹³⁾. The goal was to reduce the number of classes of the Integrated Studies and increase the number of classes for knowledge acquisition and utilization. Systematic education appeared to be dominant, but as is described in the next section, it was not that simple. The latest reform plan announced in 2017 for elementary and lower secondary schools and in 2018 for upper secondary and special needs schools focuses attention on PBL more than ever before. The Courses of Study will be implemented in all secondary schools in stages from 2021.

B. Two Vectors for Implementing PBL

1. The Courses of Study for Primary and Lower Secondary Schools

The revised 2008 Courses of Study reduced the numbers of school hours for integrated studies. However, inquiry-based learning has the same weight as obtaining and applying fundamental knowledge and skills. The importance of fostering the ability to think, make decisions, and solve problems was emphasized. This is because the Courses of Study did not change the purpose of education, that is, to foster a “Zest for life” from that of the previous 1998 Courses of Study. However, inquiry-based learning is time-consuming and in the PBL framework, knowledge is defined as a construct through the PBL processes. What did this reform mean for PBL?

Sato¹⁴⁾ explained that MEXT did not think enough about the quality of achievement by 2008 and just increased the number of classes and content, while other advanced countries reexamined their educational reforms and shifted their focus from quantity to quality. Other countries already focused on the competencies necessary to survive in a

knowledge-based society facing rapid advancement and rapid obsolescence caused by globalization. The countries that performed better in the OECD-PISA assessment than Japan, such as the Finland, Australia, and Canada, had fewer classes, whereas countries with more school hours tended to have a lower ranking¹⁴⁾. Although MEXT recognized the competencies required to live in a rapidly changing society, it took a different approach and increased the quantity of classes to acquire more fundamental knowledge and skills. MEXT's approach reminds us of the difficulty faced by medical schools before the implementation of PBL, where students that received an intensive education could not adapt to a real-life clinical setting. When it comes to MEXT in the early 2000s, the increasing quantity of classes was considered a reasonable reaction to the criticisms of the 1998 reforms that reduced the amount of classes and content.

In November 2016, the Central Council for Education submitted a report on revising the Courses of Study to MEXT. The report emphasized a new style of education for the future that nurtured a competency (*ikiru chikara*, or "zest for life") to value generic skills. What are the significant changes in the new curriculum?

Advanced countries are not only concerned with knowledge and skills nowadays but also with clarifying disciplinary or interdisciplinary dispositions and capabilities and referring to the OECD Key Competencies that influence curriculum development globally. In Japan, there has been a serious shift from the content-based curriculum to the competency-based curriculum, and the Courses of Study describe not only educational content but also the Key Competencies as interdisciplinary generic skills¹⁵⁾. MEXT framed the new curriculum as "the curriculum, open to society." The revision has put more emphasis on the relationship between schools, life, and society than ever before¹⁶⁾.

This time, PBL is introduced again under the key concept of "Proactive, Interactive and Deep Learning", which has also been referred to as Active Learning (AL). AL was first introduced to educational policy in the report for the quality-based university reform from the Center Council for Education in 2012¹⁷⁾. Two years later, AL appeared in the Ministry of Education consultation with the Center Council regarding primary and secondary school education. Responding to this movement, the 2016 reports submitted

by the Center Council for Education attached great importance to AL for improving the quality of student achievement¹⁾. Since then, AL has flooded secondary schools where teachers now cannot avoid the concept, and many books about AL can now be found on bookstore shelves.

Mizokami¹⁸⁾ locates two types of PBL (project-based and problem-based) as major methods of AL, stating six common characteristics by referring to several publications including Thomas⁴⁾ and Savey⁵⁾: 1) inquiry into a problem set in the real world; 2) fostering problem-solving ability 3) more than one solution is possible; 4) learning is self-directed; 5) learning is cooperative or collaborative; 6) a constructive approach to building knowledge deeply and socially. The purpose of education is to cultivate disposition (self-directed learning and collaborative learning) and problem-solving capability, and PBL is an appropriate form of learning to get students ready to face real world problems that span specialized and subdivided disciplines¹⁸⁾.

The current revised Course of Studies compiled in 2018 uses the phrase, "Proactive, Interactive and Deep Learning," as an overarching theme and AL remains just a view point. It is partially because AL was interpreted narrowly as just a teaching method that adopted group discussion rather than an actual shift to inquiry-based and experiential learning¹⁶⁾. The description of AL in 2014 allowed for various interpretations because AL methodologies such as group discussion and group work were specifically mentioned, but the explanation did not go beyond idealistic word, such as "Proactive" or terminologies of problem-based learning, and AL was not concretely explained¹⁾¹⁶⁾. Similar misinterpretation was reported when PBL was introduced in the United States where it was superficially adopted at first by just introducing more group work into the classroom⁵⁾. This in turn led to implementation challenges. According to Mizokami¹⁹⁾ the phrase, "Deep Learning" was added to give emphasis on learning through interaction with others to let students realize for themselves as part of the learning process.

2. Pressure from University Reform: Realizing a High School and University Articulation System

As far as high school is concerned, policy reform for higher education also puts pressure on high school teachers to adopt PBL. MEXT is currently promoting

the plan for implementing high school and university articulation reform. “On Integrated Reforms in High School and University Education and University Entrance Examination Aimed at Realizing a High School and University Articulation System Appropriate for a New Era (Report)” submitted by the Central Council for Education in November 2014 proposed high school and university articulation reform for the first time in Japanese educational policy and emphasized the importance of AL in high schools in terms of the integration¹⁾. The Central Council for Education stated that “After clarifying what sort of future Japan is aspiring for, this has been the biggest issue in educational reforms; however, it has been something difficult to make a reality.”²⁰⁾ The final report of the Council for High School and University Articulation System Reform submitted in 2016 stated that high school classes were more prone to keeping the traditional approach to learning of disseminating knowledge compared to elementary schools and junior high schools which implemented inquiry-based learning²¹⁾. The report also stated that high schools should improve proactive and cooperative learning with appropriate methods in the light of active learning²¹⁾. The report recognized the existing university entrance examination was a bottleneck, which caused high school curricula to remain focused on the traditional approach of disseminating knowledge. It proposed replacing the current university entrance examination, which focuses on reproducing knowledge, and shifting towards accessing necessary skills, especially intelligence, decision making, and self-expression. Some universities have already adapted their entrance exams for selected candidates based on the quality of student performance in high school as a whole.

AL was originally introduced with the American university reform of the 1980s to break away from the traditional lecture-centric learning and to adapt learner-centric learning including group work and problem-based learning. Japanese university reform adopted AL for the same reason^{16) 19)}.

4. Implementing Challenges

A. Status of PBL Implementation in High Schools and its limitations

The revisions to the Courses of Study represent attempts to implement education policies that engineer a society and

policymakers carefully research currents and challenges inside and outside of Japan, so we need to examine the experience of experts, municipal governments, schools, and teachers on site²²⁾. As Honda¹⁾ is concerned with the gap between the clear vision of promoting quality learning and the idealized words of “proactive,” “active,” and “collaborative”, she gave a questionnaire to high school teachers throughout Japan on the extent to which AL is actually used in high schools. The results showed that almost half of teachers/supervisors responded that they implemented participatory learning regardless of style. Most of them engaged students in experiential learning through student presentations, brainstorming, and group discussions. When it comes to the more precise definition of AL, where students set their goals and research, like PBL, the response was less than 10%. The study shows why there is a limited implementation of research-based AL: not enough learning time in the school curriculum, not enough room in the school budget, and teachers with inadequate research methods¹⁾. Ishibasi²³⁾ studied the guidance and support provided by teachers for high school students to explore PBL through writing a thesis by setting their project themes themselves. It reveals that differences in guidance and support are observed between the teachers with over 15 years of teaching experience and those with less than 15 years. The expert teacher takes a more holistic approach to each student.

On the other hand, there are some high schools that have a high implementation rate of research-based AL. These high schools are designated as Super Science High schools (SSH) or Super Global High Schools (SGH). SSH is a program established by the Japan Science and Technology Agency (JST) in 2002 under MEXT’s supervision. The program encourages an examination of advanced science and math education, research of high school and university articulation, and development of instructional methods that foster creativity and originality with the goal of preparing capable students for university. MEXT appointed selected high schools to engage in research-based PBL that are like university activities such as proposing and conducting research and presenting results. A university researcher is assigned to be a supervisor by the high school. As a result, more academic conferences are opening their doors to high school students to present their research than ever before. According to Gamo and Ono²⁴⁾, PBL in SSH merged into

PBL in Hours of Integrated Studies in high schools. PBL practice in SSH can be divided into two types explained by the following two metaphors: a building with two stories and a building with an open ceiling²⁴. Two-story PBL indicates that PBL lasts up to the second year of high school and then switches to preparation for university entrance examinations, while an open ceiling PBL means that PBL is continued throughout all three years of high school. When the current entrance examination system changes to measure multiple aspects of students' achievement, this type of differentiation may change too. SGH has a similar framework to that of SSH. The SGH program started in 2014 by MEXT to support curriculum development and application with partners such as universities, companies, and international institutions in and outside of Japan. The aim is to raise globalized leaders and to cultivate students' interest in social issues, and raise communication skills, problem-solving skills, and a sense of global awareness²⁵. It is assumed that the program plays a part of building the high school and university articulation system in advance²⁶.

B. Hours of Integrated Studies vs. Disciplined-centered Learning

Why do some high schools still hesitate to adopt PBL/AL? Some teachers have said, "PBL is for Hours of Integrated Studies and not for each discipline" or "it is too difficult to practice even though we would like to try"^{2) 18) 19)}. As is mentioned above, historically PBL in Japan was introduced smoothly into Hours of Integrated Studies. It worked better to integrate PBL into primary and lower secondary school curriculum than into high schools, and that is partially because teachers accepted that high school disciplines are too specialized to create an interdisciplinary curriculum and to raise problem-solving capability by inquiry-based learning compared to those of primary and lower secondary schools²⁾.

The discrepancies between Hours of Integrated Studies and other disciplines were anticipated during the early stages of developing the curriculum for Hours of Integrated Studies. In 2010, inquiry-based learning had already been isolated into Hours of Integrated Studies and knowledge acquisition and utilization were covered by each discipline²⁷⁾. It is assumed that the 2008 revised Courses of Study caused the discrepancies because it introduced inquiry-based learning to balance the existing curriculum of

systematic education that had knowledge acquisition at its foundation.

There is another argument that challenges the concept of the inquiry-based learning, which MEXT mentioned. MEXT's intention was to locate the inquiry-based learning after mastering and applying knowledge. That is different from what is called inquiry-based learning where knowledge is constructed through interactive activities in a meaningful and specific context. PBL in Hours of Integrated Studies is not enough to foster competencies required for the future¹⁸⁾. The competencies should be generic to solve problems that cannot be easily solved in an unpredictable and complex society. In that respect, these competencies should be acquired through hard work in each highly specific discipline either to integrate different ideas.

5. Discussions on PBL implementation

A. The Significance of Setting Driving Questions

It has been two decades since inquiry-based learning was introduced to Japanese education as part of the Hours of Integrated Studies. However, PBL implementation in high schools has been very limited. The discrepancy is between Hours of Integrated Studies with more PBL classes and discipline-centered subjects with less PBL. The Courses of Study not only specify aims but also list contents, which means that teachers tend to explain the lists and teaching turns into knowledge dissemination. Uesugi²⁷⁾ suggests that it is important to think how to foster competencies and proposed imagining competencies to achieve this aim and take content lists into account with more freedom to produce content based on context.

To overcome the problems with producing curricula and lesson plans, some positive practitioners apply the backward design developed by Wiggins and McTighe in the late 1990s. Narita²⁸⁾ applies the design suggesting that high school teachers start by imagining the personnel of the future they want to create instead of jumping into thinking what to teach. That is, proceeding backwards step by step. Narita still encounters some problems among Japanese teachers and states that the first obstacle teachers encounter exists between the first two steps. The second step is to imagine the knowledge, skills, competencies and disposition to foster. He further recommends having a workshop with people other than teachers that help support

implementing PBL in Japanese high schools. In other words, it is important to examine the aims and contents of the disciplines and to set interdisciplinary themes and activities by imagining the future and their activities in society because it verifies concrete contexts which allow locating views on disciplined subjects for examining proposes and contents¹⁵⁾.

Other publications on AL also point out the value of the backward design and the collaboration between teachers and organizations. Implementing AL in different high schools, Shimomachi²⁾ realized that changing only the teaching style will not help in designing a project that deeply engages students. Changing the mindsets of teachers and schools is necessary. In order to do this, he mentions several things that can be done, such as making a five-minute informative clip of AL to inspire other teachers and to promote a feeling that they too can successfully implement it in the classroom.

This backward design of PBL can breathe new life into a school. Teachers at Horikawa High school in Kyoto prefecture were facing a dilemma on which direction to take: to have more students passing university entrance examinations or to have more students with the ability to succeed after university. It is a dilemma because in Japan these often contradict each other due to the way university entrance examinations are designed. In Horikawa High, teachers decided to pursue both aims. They recognized that passing entrance exams and succeeding in society are both goals for students. Teachers started to envision a school in which teachers would like to have their own children attend²⁾. For students to find their meaningful future purpose, teachers created a subject, called "*Tankyu kiso*" ("Inquiry basic") where students pursue a theme by research-based PBL. During the first year, students learn how to formulate research questions based on their interests and then hold small seminars with other students to come up with an approach to tackle the project. This is followed by writing individual papers during the second year. There is a student committee to assure the quality of the inquiry class through prior discussion with teachers and teaching assistants from universities. The PBL approach took the role of reforming the school system itself. The number of students who passed university entrance exams increased to 106 in 2002 when the first generation that was the product of this reform graduated, compared to only 6 the year

before²⁾. Horikawa High School was appointed an SSH in 2002 and an SGH in 2014. The PBL approach through SGH and SSH supports the student-centered school system.

The PBL approach can be effective when it is implemented within the right context. However, there are also pitfalls. Commentary on problem-based learning in the Japanese translation of the Cambridge Handbook of Learning Sciences states that if someone applies problem-based learning beyond its range without understanding the meaning behind a question, the curriculum will be mismatched²⁹⁾. Krajcik and Shin⁶⁾ repeatedly affirm the significance of selecting driving questions. It should be a question which focuses the content and clarifies the next step. Teachers are required to develop materials which encourage learners to learn through inquiry. As noted earlier, Krajcik and Shin⁶⁾ identify "engaging in scientific practices" as one of the characteristics of effective project-based learning. In the 1990s, it was noticed that many students lacked motivation to learn science. In this context, the curriculum changed from covering many topics superficially to being more project-based through a collaboration between science teachers and policymakers. This means that engagement with real-life application is valuable, and this is true not only for the scientific community but for all communities, as is verified by research on situated learning.

B. Styles of PBL in the 21st century: Regional PBL and Global PBL on Community Revitalization and Sustainability

As we have seen, PBL has been implemented in Japanese secondary education in several different contexts. When PBL is adapted as a way to design the curriculum, promising practices have evolved in Japan. The common features of these practices can be seen regionally and globally. Taking a meaningful question in a real setting is the essence of PBL. Among them, PBL based around community revitalization and sustainability became significant as students and teachers have a mutual relationship with the region. Sometimes students even become powerful actors in contributing to the region. PBL that take a locally relevant theme became increasingly common especially after the 2008 Course of Studies. However, recent PBL differ from past PBL in the depth of the relationship schools have with their regions, the variety of people students and teachers

work with, and the changes happening in schools.

A project to make high school more attractive evolved from a regional PBL of Okidozen high school and became a model case for other high schools in Japan. The high school is the only school on an island in Shimane prefecture. The declining population, including students, is a problem in various ways. The number of students is too small to have a full school staff, so sometimes there is no physics teacher³⁰. Some students moved to the mainland to go to high school in search of a better educational environment, and these students tended not to return to the island after graduation. It is a vicious cycle. Not only students and teachers but also community members and administrative officers implemented PBL to revitalize the community and promote sustainability. This in turn attracts junior high school students to choose to go to the high school. The high school has a dormitory where students from outside the island live, and this impacts the community. Career education is also offered by the public cram school, which was established for this project to invite students living in and outside the island to envision life in university and the competencies required in society after graduation. There were 28 students when the project started in 2008, and the number reached 65 with two classes in one grade. After achieving this goal, the school is engaged in SGH to pursue their next goal.

C. The Global PBL: Practices Promoted by the Japan Innovative Schools Network (ISN), Supported by OECD

1. The Educational Trends Toward 2030 Society

There are many recent examples of students and teachers attempting to set a driving question with a global context responding to recent educational trends³¹. The United Nations Sustainable Development Goals (SDG), adopted in 2015, promote much more open access to education in addition to realizing a better and more sustainable future for all. The targeted challenges of the SDG include poverty, inequality, climate, environmental degradation, prosperity, and peace and justice. OECD started a new project called the OECD Future of Education and Skills 2030 (OECD Education 2030) in 2015 where not only policymakers and experts but also teachers and students are involved with examining competencies (knowledge, skills, attitudes and values) and instructional systems³². OECD Education 2030 succeeded the OECD DeSeCo project (1997-2003) which

defined and selected the Key Competencies and influenced educational reforms worldwide. Taking rapid social change into account, OECD Education 2030 targeted on elaborating adequate competencies as well as realizing curriculum on site, involving more than thirty countries, including Japan.

2. PBL Practices of Innovative Schools Network (ISN), supported by OECD

More specifically, in April 2015, the Japan Innovative Schools Network (ISN), supported by OECD was established to support secondary schools to develop new educational systems for the 21st century through international collaborative PBL. Since then, ISN has been working with Japanese secondary school students to explore solutions to overcome challenges currently facing their communities or challenges they will face in 2030 such as the deterioration of local economies and rapid depopulation. All schools supported by ISN took a PBL approach with themes that focus on SDG related issues, especially community revitalization. The reason ISN focuses on community revitalization and sustainability is that the organization traces back its origin to one project called the OECD Tohoku School. The project began in 2012 to support students in the Tohoku region of Japan, which was devastated in 2011 by earthquakes and a massive tsunami that caused the nuclear power plant accident. Community revitalization and sustainability are still big issues in many communities in Tohoku, and for that reason they became a focal point of action for ISN. OECD and ISN recognize that there is a huge gap between the current curriculum and the curriculum needed to shape a better future. Administrative measures are not enough to drive a new type of educational system.

Based on the remarkable success of the OECD Tohoku School, INS 1.0 was put in place as its successor for three years in 2015. INS 1.0 called for Japanese secondary schools and six clusters based on five areas and one type of school evolved: Tohoku region, Hiroshima Prefecture, Fukui prefecture, Wakayama prefecture, Shimane prefecture, and colleges of technology (*Kosen*). Students in Tohoku tackled urgent problems related to disaster restoration with no specific solution. By researching regional revitalization issues, students analyzed local problems and gained an interest in promoting local shops and finding attractive local resources such as one of the world heritage sites located in

the prefecture. Some school groups organized events for local people, as well as people from overseas. Other school groups produced advertisements used by local TV stations, while others promoted new merchandise representing their region³¹⁾. These types of PBL also foster entrepreneurship.

In addition to community revitalization, ISN PBL highlight international collaboration. Schools had international partners from eight countries: Estonia, Germany, Indonesia, New Zealand, Singapore, the Philippines, Turkey, and the United States, to promote community revitalization and sustainability collaboratively. The Hiroshima cluster held the so-called international school at the end of each year with their international partners. Eighteen schools, both public and private, were teamed up by the Hiroshima educational board. It was an experimental effort that existed outside of the daily curriculum, but many schools chose to integrate it into their classes. Each school had a mission, which was rooted in local issues, but students came to realize that many local issues have similar challenges and global concerns³³⁾.

In 2016 an intercultural educational program “Partnership for Youth Shaping Vision 2030”, was organized by the East-West Center in Hawaii and Hiroshima Prefectural Educational Board. The basic theme was “community revitalization” and “sustainability.” Some Hiroshima students shared stories told by American survivors of the Japanese bombing of Pearl Harbor in Hawaii with students from other countries including the Philippines, and they came to realize that Japan was not only a victim but also an aggressor in the war. This notion has special value in Hiroshima because of the dropping of the atomic bomb during the war. The students were concerned in the early stages of PBL about how to pass down the memory of the atomic bomb because of the decline in the number of survivors. However, after the global collaboration, students realized that Japanese peace education was not complete because their teaching material tended to emphasize the cruelty of atomic bomb while not paying attention to the other victims in the war³⁴⁾. They learned that community memories would become sustainable only when those telling or retelling those stories are able to convey multiple viewpoints through interactions with other communities. Some ideas had never been thought of before and they could learn from each other and teach each other. This drives students to share what they have in common with each

other locally and globally to overcome difficulties together. SDGs played the role of the common language with which students from multiple countries learned collaboratively³³⁾. By not only collaborating with teachers but also with various people outside of school, such as researchers, business people, town officials, farmers, and peers in other countries facing challenges in their region, students tried to achieve their own goals regarding community revitalization and sustainability. In Fukui, secondary school teachers and university researchers worked closely together and some schools came to introduce an essay type of test as one of the new assessment tools besides traditional examinations that test the ability to reproduce knowledge³⁵⁾.

At the very end of the project, ISN 1.0 compiled design principle guidelines for international collaborative PBL that school teachers and researchers had put together over their three-year endeavor³⁵⁾. In this ISN PBL, teachers tried their ideas more freely and with greater variety compared to other PBL. This type of PBL should increase if support is given by local administrations or even at the national level. However, there isn't such a system in place yet. ISN entered its second phase in August 2018 to support implementing international collaborative PBL further into school curriculums and applying the research results of ISN 1.0. The pilot studies on the development of global competencies report the result of a self-assessment survey for students³⁶⁾. According to the reports, students felt confident in their growth in both “interest in novelty” and “openness towards cultural diversity.” Oral communication was emphasized over written communication. Long-term global collaborative PBL experience may foster students' confidence in expressing themselves and the acceptance of other's opinions.

6. Challenges for Future Implementation of PBL in Secondary Education

There are many arguments on what to teach and how to teach, but the current challenge for PBL in secondary schools is to change the mindset of schools and teachers in how they apply PBL. As we have seen, implementation of PBL in high school is very limited, though it has worked effectively in certain, unique schools, such as SSH appointed schools (only 5 % of all high schools). Therefore, teachers and schools need more social support

for successful PBL implementation. INS uniquely supports high school students and teachers to use global collaboration as a resource for driving questions. It is assumed that ISN PBL is not a requirement of the Course of Studies. However, PBL implementation in the classroom should increase if it is given more support.

High school is responsible for developing the human resources of tomorrow. Even though effective PBL application is increasing, there is no further support for students after graduating high school. That is also a future challenge. When students found value in community revitalization, they became agents for social change. The Hiroshima student who could recognize peace and sustainability in a multifaceted way through international collaboration was able to do so through encountering different viewpoints. Different viewpoints don't necessarily mean just foreign viewpoints, but also from people of different ages, different environments (coastal or inland; urban or rural), even from different schools. However, the international aspect is a powerful way for Japanese high school students to realize the differences and also the commonalities between people³¹⁾. It is necessary for schools and local educational boards to work with social organizations such as museums and NPOs to gather different points of view. For example, the East-West Center, an NPO in Hawaii which has over fifty years of experience in supporting youth to become leaders in society, encourages students from elementary school through to university and offers some support for adults through PBL programs. Schools are able to bolster their weaknesses in promoting PBL by finding the necessary support partners from existing organizations in society. There is also some critique that PBL implementation tends to limit itself for those students that go to university. However, there are many students who do not go to university and go directly into the workforce, and sufficient PBL is necessary for those students that directly enter the real world right after graduating high school.

Regarding assessment, there is not much research on the PBL performance of high school students. Ishii¹⁵⁾ suggests that assessment should be based on the targeted quality of achievement, meaning that the assessment is to measure learning in a real context and the thought process should be evaluated. Rubric and portfolio are popular ways of evaluating student performance in a learner-

centered curriculum. The rubric is originally based on each teacher customizing for each student a formative evaluation. In addition, it has become popular to apply rubrics for evaluating several curricula systematically with set standards³⁷⁾. There should be more research to uncover the best strategy for student evaluation at the early stage of implementation besides just evaluating achievement. Since the school system is focusing on the future concerns of students to have a better life in society, long-term assessment is needed for the future.

7. Summary

PBL implementation in Japanese secondary school education has more momentum than ever before. The current challenge to high schools is to actualize PBL application in schools, even though it has been two decades since inquiry-based learning was introduced to Japanese education as a part of Hours of Integrated Studies. The reason why the status of PBL implementation in high schools is very limited is rooted in the historical background of PBL. Generally, PBL in Japan has been implemented as part of a move towards experiential education since the early 20th century, while being compatible with two approaches; systematic education and experiential education.

PBL application in Japanese secondary school education is presently facing challenges in moving from systematic education to experiential education under the pressure of primary and secondary school curriculum reform and of high school and university articulation reform. The implementation of PBL in high school is very limited, though it has worked effectively in certain, unique schools, such as SSH and SGH appointed schools. Inserting PBL into disciplined subjects is the biggest challenge. In Japan, there has been a serious shift from the content-based curriculum to the competency-based curriculum and the 2018 Courses of Study describes not only educational content but also the OECD Key Competencies as interdisciplinary generic skills. However, teachers have little experience in fostering generic competencies for the future. If teachers and schools do not overcome this challenge, PBL will turn into just a simple class activity without real learning and will not be implemented properly. The backward design approach has been acknowledged as effective in imagining the kind of

adults the students will become in the future. To make the PBL approach more effective in schools, setting a driving question based in the real world is effective. Taking a meaningful question in a real setting is the essence of PBL, and if they are based on locally relevant topics such as community revitalization and sustainability, they can be powerful because students and teachers have a mutually beneficial relationship with the region.

Teaching and learning around PBL should not be limited just to school and should involve a diverse collaboration of partners. Effective PBL can even change a school and community and provide children with a better life. To achieve that, the schooling system is not enough, and a great deal of support is necessary for teachers. Organizations with a local mission, such as museums and NPO's are favorable possibilities in addition to governmental support. Multiple types of collaboration with students and other stakeholders is a promising way to examine PBL based curriculum for each school. More research on the implementation process is necessary as well as an assessment of current practices to grasp the effectiveness and challenges of successful PBL implementation.

Education reform is a major concern for countries around the world. There is no singular, ideal method of educational reform that can be followed universally by all countries because educational systems are products of the various societies and cultures they serve. It is vital thought to learn from the experience of educational reform in various countries to better understand the impacts and benefits of various approaches to educational reform.

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