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Conceptions of Inquiry-based Learning in High School Biology in Japan and China

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Abstract

In the face of the ongoing globalisation of the world, changes in industrial structures and the accompanying arrival of a knowledge-based society, countries around the world are searching for a new vision of the future of school education under the name of educational reforms. Among them, the speed of educational reform in Asian countries is tremendous, and it is a fact that Japan and other East Asian countries (including Japan) are the most important countries in the world in terms of educational reforms. Among them, the speed of educational reform in Asian countries is tremendous, and it is a fact that Japan and other East Asian countries (South Korea, Taiwan, Hong Kong, Singapore and China) have achieved in less than a century the modernisation of education that took Western countries two or three centuries to achieve slowly, drawing on the experience of Western countries. drawing on the experience of Western countries.
It was the first major revision in 10 years in Japan and the first in 16 years in China, and a major It was the first major revision in 10 years in Japan and the first in 16 years in China, and a major feature of the revisions in both countries was the trend towards a change in education that emphasises student enquiry and practice in order to develop a From a historical perspective, both countries have a top-down approach, with one teacher in charge of a class standing on the lectern and teaching approximately 1,000 students. However, the educational reforms in both countries aimed to move away from an However, the educational reforms in both countries aimed to move away from an examination-oriented education and shift to competency-based education.
In this study, while the emphasis is on inquiry courses, we look back at the history of education in both countries, focus on the meaning of inquiry activities as defined by each country and the purpose of inquiry activities, explore what kind of inquiry education is unique to Japan and China, and in the process, formulate a unit plan for high school biology that cultivates scientific inquiry skills that fits the education in both countries, and develop a The aim is to create a high school biology unit and a concrete lesson plan that fosters scientific inquiry skills that fit the education in both countries. education in both countries.

Keywords: *inquiry learning, history of education, teaching vehicles, curricula.*

1. Research background.

The growth of a country's people has become essential for its prosperity, and the quality of education in schools is one of the main factors, perhaps the biggest factor, in developing people. Schools are therefore called upon to adapt to rapidly changing social conditions and to actively educate children to acquire the qualities and abilities they will need when living in the future society.

At present (2023), Japan's latest Courses of Study were revised in 2017 and fully implemented at the compulsory education stage from April 2020 for elementary schools and April 2021 for junior high schools. The 2017 Courses of Study emphasised the importance of "fostering the qualities and abilities for life so that children can create their own future" and set up the "ability to live" as one of the three pillars of the Courses of Study. In the specific curriculum to lead to the 'ability to live', it is stated that "the content of what is taught in each subject is important, but there are many things that should be nurtured not only in specific subjects but also in all subjects, such as the ability to use information, to find and solve problems and the qualities and abilities required to deal with various contemporary issues" (omitted). Many of them are nurtured not only in specific subjects but also in the context of all subjects." *1.

At the same time, from 2022, the Compulsory Education Curriculum Plan (2022 edition) and Compulsory Education Curriculum Standards (2022 edition) were also fully implemented in China. China's Curriculum Standards (2022 edition) speak of aiming for a holistic education, aiming to develop the qualities and abilities for the following three points: having ideals, beliefs and a sense of social responsibility; having scientific and cultural literacy; and having self-development, communication and cooperation skills. A proposal for educational reform has been presented.

From a historical perspective, both China and Japan have reformed primary and secondary education in a top-down fashion. In the past, education was mainly provided by a single teacher in charge of teaching a class of about 40 students. However, the aim of the educational reforms in both countries was to move away from an examination-oriented education and shift to competency-based education. In the new classes, group work activities by students are also being emphasised. This is because today's world demands people who can think and make decisions on their own, rather than people who can do what has been decided in an organisation.

However, it is also a fact that major barriers stand in the way of a breakaway from conventional school education and a shift in its role and function towards the training of human resources for the future society. These challenges and issues require that the policies and systems surrounding schools are revised to change the daily classroom teaching practices, and that not only the national and school levels, but also the whole society, including teachers and citizens, become active actors in pursuit of change at the level of practices in the classroom.

2. Objectives of the study.

In China, competitive schooling with an emphasis on exam preparation has continued, with the popularity of self-funded study abroad in the 1990s at the forefront, and the use of cram schools for children becoming more common, leading to intensified competition for examinations. Learning, which also affects children's development, has become a major social problem, and the Chinese Ministry of Education began to reduce the burden on students and reform education in the 2000s. The focus of this educational reform has been on education to develop human resources who can not only memorise knowledge, but also understand and utilise it.

Although inquiry-based learning has already been developed for a long time in the West, there are still many challenges in integrating it into classrooms in Japan and China. One major problem is that both countries are still dominated by passive teaching styles in school education rather than active active learning, due to the high level of competition in examinations, the large number of students in relation to the number of teachers, and the lack of teacher skills.

The aim of this study is to draw attention to the implications and purposes of inquiry activities as defined by each country since the 2000s, when both China and Japan began to encourage inquiry-based learning, and to develop a unit concept and specific lesson plans for high school biology that cultivates scientific inquiry skills to suit the education of both countries in this context.

3. The process of enquiry and specific examples of enquiry to conceptualise enquiry-based learning.

In the West, there has been a long history, spanning several centuries, of the creation of inquiry-based learning. The origins of such pedagogic methods are attributed to the Socratic method of question and answer in ancient Greece and to the work on inquiry by the educational thinker John Dewey in the early 20th century.

Inquiry, as described by the US National Science Education Standards (Next Generation Science Standards, NGSS) as of 2023, is a multidimensional activity that involves observation, problem posing, reading materials, designing experiments, making predictions about experiments based on prior research and experience, collecting and analysing data, and finally discussing results and Finally, it is a multidimensional activity involving discussion of results and interaction about the experiment. Even if it is inquiry in an educational setting, inquiry learning is a learning process in which students participate independently and actively acquire knowledge, and it is a way of learning in which students themselves seek out what to do and how to do it.

3.1 The process of problem solving and exploration activities as presented in China.

Since ancient times, China has been a country that places great importance on the education of 'courtesy' and 'morality'. Confucianism was the main source of education and taught students the 'Way of the Sovereign', which was mainly based on benevolence, propriety, courtesy and wisdom. In this context, Daoism, which was born at the same time as Confucianism, followed the exact opposite path to Confucianism. Education that inspires rather than instructs; education that makes one feel nature rather than instructing etiquette; this is nature education in Taoism. The Taoist philosophy of nature education had a great influence as a foundation for science education and exploratory learning in China. What is the nature-based education that has been handed down over the past 3,000 years?

Western nature education thought began with the ideas of ancient Greek philosophers. In China, too, natural education thought began to be discussed in the Spring and Autumn and Warring States Period, which was the same period as the ancient Greek period. The ideas that emerged during the Spring-Autumn and Warring States Period are so numerous that they are said to be "a hundred schools of thought". The representative schools are the Confucian school, which emphasises education and etiquette, led by Confucius (B.C. 551-B.C. 479); the Taoist school, which teaches the Way and nature, led by Laozi (B.C. 571-B.C. 471); and the Buddhist school, led by Sumi (B.C. 476-B.C. 476). C. 476-B.C. 390), which emphasises political economy. Of these, the Taoism narrated by the Taoists had

a profound influence on nature and inquiry education in later China and became the root of Chinese thought.

Just as there is a 'god' in Christianity and other religions, Taoism has its own beliefs. In Taoism, there is a spirit in all things and a 'way' in all things. But the Way is not something that can be interpreted and described collectively in words, and if it can be expressed in words, it is the everlasting Way, which has no permanent significance; the same is true of names, which can be named, but have no constancy. 'Nothingness' is the source of the universe, which represents chaos, and the 'existence' (form) of all things in the universe is brought about by naming. Therefore, it is important for us to experience the edge of the Way by observing 'existence'. Observing 'nothingness' and 'existence' is the gateway to understanding the deepest and most ineffable aspects of change in all things. This idea is very similar to entropy and chaos theory in the West.

In human society, too, the Way exists in all areas of society, and human activities and the laws of nature are based on the Way. Although the characteristic of education is to convey to people the rules and norms of nature or society, it is also said that "the way, the way, the non-way; the name, the name, the name, the very name." As is also said, many things in this world can only be learned with the mind, but cannot be expressed concretely in words.

With the end of the Great Unification Era of the Han Dynasty, the imperial court underwent a brief period of change and society began to become unstable. The Wei Jin Northern and Southern Dynasties (A.C. 220-A.C. 581) was characterised by an era of openness of thought, rich individuality and carefree elegance. Many natural educators arose, and people searched for a new kind of education different from the Confucianism that had been promoted by the people.

その代表格が嵇康（A.C. 224-A.C. 263）である。魏晋南北朝時代は個性豊かな時代であり，この時代の者たちは皆豪快でさっぱりとしていたが，嵇康はその中でも突出して個性的だったとされている。嵇康は魏朝の思想家，音楽家，文学家であり，今までの礼儀教養を突き破り，人のより自然で率直な自我の表現を重視した。彼は「越名教而任自然」の観点を提唱し，当時の教育の主流である儒教の綱常礼教のような強制的な教育を否定し，万物の本性（自然）に沿った教育を行うことで，人はより良い発展を迎えることができるとした。

3.2 The process of problem solving and exploration activities as presented in Japan.

Unlike China, the history of Japan differs from that of China in that Japan has not fostered its own civilisation within its own borders, but has developed into a unique culture through the fusion of the wisdom of various countries and regions.

Ancient education in Japan was not as systematic as today's systematic school education, or even as significant and concrete as that of the temple hut, but was a method of accidental transmission of the educator's experience to the pupils. The people did not consciously have ideals for education, but learned by following the example of adults in order to inherit the Shinto rituals and professions. The culture of prehistoric Japan was Shintoism, known as koshinto or pure Shinto. Shinto was a naturalistic and simplistic ideology, with the idea of loving and worshipping nature and enjoying this life as much as possible. In ancient times, people regarded all great and wondrous things in people, nature and natural phenomena as gods, and worshipped them as the eight million gods. Although Japan has adopted many ideas from other countries in later times, this natural simplicity of Shinto thought, which has existed since ancient times, has always been an important part of Japanese thought.

The arrival of Confucianism and Buddhism in Japan brought about major changes in Japanese culture and education. The previous ideology, which mainly focused on familiarity with nature, was replaced by Confucian moralism, which emphasised the importance of people and their behaviour.

The early modern period is the most important period for the development of inquiry and science education in Japan. In early modern Japan, as in China during the Spring and Autumn and Warring States Periods, many schools of thought developed and a variety of educational ideas emerged. Christianity was introduced to Japan by Francisco Xavier, and new knowledge and technologies related to various Western sciences and arts were introduced to Japan for the first time. It was during this period that Western systematic education began to be introduced into Japan.

The Japanese who first came into contact with Dutch studies were fascinated by the mysterious and fascinating science and technology and the world they embodied. Education also underwent major changes, including the use of Western forms of education and teaching systems as they were.

A representative educational philosophy of the mid-Meiji period is that of Johann Friedrich Herbart. Herbart is said to have been the first person to systemise education scientifically, and his five ethical goals of inner freedom, perfection, goodwill, justice and fairness are said to have been supported by the Confucian principles of benevolence, justice, propriety, wisdom and faith. The form of the educational method initiated by him was also appreciated by Japanese educators at a time when there was a tendency to impose it into a mould.

In contrast to Herbart's neatly framed education, Friedrich Junge's theory of science education is a theory of life coexistentialist education. The educational methods recommended by Junge emphasised observation of actual living organisms such as animals and plants, taking up materials from the land itself where children were present and children's experience, as well as children's thinking to find laws and causal relationships in the natural world through the interplay of observation and interpretation.

Yunge's education on living togetherness may be considered similar in some respects to the Chinese Taoist philosophy of nature education. However, whereas Taoist nature education attempted to separate nature from life (human activity), Junge pointed out that the concept of life lay at the heart of nature and that it was important to begin teaching from the essence of life. Junge's teaching works from the child's rudimentary intuitive perceptions to the discovery of laws in the living coexistence. However, the greatest drawback of Junge's teaching method is that it does not realise the unitisation of the contents of the teaching material, and, as in Taoist education, it is very difficult to understand how exactly the ideas should be formulated in education.

4. The necessity of studying biology in school education

In modern society, it is difficult to make appropriate decisions and choices without a background in biology, whether in daily life, industrial activities or in policy-making on the environment and health. Advanced technologies based on biology, such as gene recombination technology, pluripotent stem cells and genome analysis technology, exist everywhere in society, and new technologies are constantly being created. When using advanced technologies, there are concerns not only about the revolutionary benefits of the technology, but also about the possibility that the use of the technology may lead to problems that are difficult to solve. In order for individuals and society to make appropriate decisions and choices regarding the use of new technologies, a deep understanding and up-to-date knowledge of biology and other disciplines is essential.

Biology as a basic education is essential for the development of an ethical view of biology and the environment, regardless of whether the subject is science or humanities. Organisms that have undergone mutations, mutations and evolutionary processes have a history and uniqueness that cannot be predicted from other disciplines alone, and there are also many phenomena that act differently at different levels of the hierarchy. Therefore, there are many possible answers to the 5W1H question in biology that can be validated. Studying biology is expected to foster qualities and abilities such as advanced cognitive, analytical and decision-making skills for understanding complex subjects and solving problems, without being overly preoccupied with individual specialist knowledge. *

Biological education is an important part of science education, and the objectives of science education are also the objectives of biological education. The origin of living organisms is the origin of science itself, which began when mankind tried to use nature to create his own place on earth, his own dwelling place. In other words, the primary reason for teaching biology education is to convey mankind's current position on the planet and to enable them to utilise nature in their lives. It can be said that scientific knowledge is acquired by expanding knowledge through experimentation and observation, finding problems based on the knowledge, devising methods of experimentation and observation, and repeating the process of trying to acquire new knowledge.

5. Elements for conceptualising inquiry-based learning.

Inquiry science researcher Margus Pedaste, in 'Phases of inquiry-based learning: definitions and theinquiry cycle', (2014), defined inquiry-based learning as, in other words, a teaching strategy in which students are encouraged to construct concepts by defined as an instructional strategy in which students follow the same methods and practices as professional scientists in order to construct concepts. Inquiry-based learning is often seen as an approach to problem-solving and requires the application of several problem-solving skills. It can also be defined as a process in which learners formulate hypotheses and then test them through experimentation and observation to discover new causal relationships. Various approaches to exploratory learning in the West exist. In most cases, exploratory learning can be divided into five stages. Planning, Conceptualisation, Investigation, Conclusion and Discussion.

Inquiry-based learning in China is a form of learning in which problems are discovered, analysed and solved through inquiry activities in order to develop students' creative awareness and practical skills, fully reflect students' independence and initiative, and aim for a deeper understanding of knowledge and competence in science, humanities and other disciplines. Inquiry-based learning is a kind of integrated learning, which includes inquiry in the classroom and inquiry-based learning including experiments and observations, inquiry in compulsory subjects and inquiry in integrated practice (the subject of integrated learning time in China) and thematic learning. Therefore, inquiry-based learning naturally includes not only knowledge within the subject, but also content from the areas of morality, culture, sports, science, etc.

He also said that when conceptualising inquiry-based learning, Chinese educator Shi Liangfang's Teaching Theory: 课堂教学的原理, 策略与研究 should pay particular attention to the following five points.

① Not singling out exploratory learning per se
② Both individual and group activities are important
③ Theory-based practice, theory developed in practice
④ Both independent student learning and teacher guidance are essential.
⑤ Emphasis on the concept of inquiry in general guidance and education.

The inquiry activity process is very similar to scientific research. However, there is a fundamental difference between enquiry activities and scientific research. Inquiry activities are a kind of learning

method, a 'learning' activity that takes the form of 'research'. Such activities focus on the research process rather than on the results of the research, and the most fundamental goals of the students' activities are (i) the acquisition of knowledge and (ii) learning how to acquire and use knowledge. Of these two goals, the second should be given the greatest importance.

Meanwhile, in Japan, the Ministry of Education, Culture, Sports, Science and Technology (MEXT) announced in March 2023, "The Development of Comprehensive Time for Inquiry to Enhance the Skills Required Today: Enrichment of Inquiry and Realisation of Curriculum Management for the Development of Solid Qualities and Abilities to Pioneer the Future Society (High School Edition)", which describes inquiry-based learning in Japan as It is a learning process based on the knowledge and skills acquired through studying the subjects up to now, and is a form of learning that enables students to gain a deep understanding of the content of their studies in relation to life and society, to acquire the qualities and abilities required in the future, and to actively continue learning throughout their lives. The book also describes it as a form of learning that enables students to continue to actively learn throughout their lives. There are two main points of guidance for enquiry-based learning described in the book. One is to make the learning process a process of inquiry, and the other is to make it a learning activity in which students work independently and in collaboration with others.

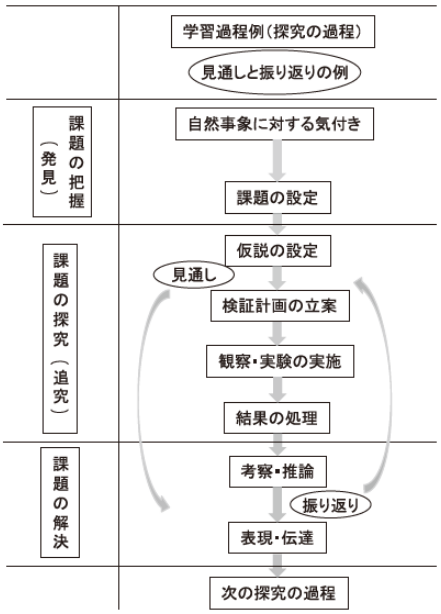
In addition, as explicitly stated in the description, enquiry-based learning needs to emphasise learning activities that seek to solve problems independently, especially in collaboration with different and diverse others. The significance of collaborative learning in enquiry-based learning is that it exposes students to a diverse collection of information. Even when learning activities to research the same issue are carried out, different people focus on different directions, different methods of collection, etc., so that a diverse and large amount of information can be obtained in the process of cooperative learning. The type and quantity of information is an essential prerequisite for the quality of the organisation and analysis of the exploratory activity, and the combination of different perspectives and different ways of thinking can add depth to the organisation and analysis of problems and issues. No matter how much material a student reads and how much literature he or she researches, there is only so much that he or she can realise and discover. Discussions, exchanges of ideas and debates, where decisions and judgements have to be made, also help students to compare, categorise and relate the information they have gathered.

Having identified the components of enquiry-based learning in Japan, China and the West, we found that it was often written in terms of two aspects: the actual enquiry-based learning and the methods used. Although inquiry varies from researcher to researcher, the most widely accepted methods of Western and Japanese exploratory learning are often divided into four stages: problem posing, information gathering, research and analysis, and summarising, with discussion interspersed between these four stages. And in conducting exploratory learning. It has been found that it is important to use the idea of enquiry in teaching, even during general instructional teaching, rather than singling out enquiry-based learning per se. Although the term 'inquiry-based learning' brings to mind experimental classes and classes with large-scale activities, actual inquiry-based learning is a learning method that can also be used during general learning activities, and it is desirable to use inquiry-based thinking to promote learning, even if there are no experiments in the class.

6. Biology unit model concept to enable the development of scientific enquiry skills.

Biomimetics is an interdisciplinary approach to developing new technologies, materials and systems by mimicking the morphology, functions and processes of organisms in nature. Biomimetics has long been a technology that has attracted worldwide attention, and there are many examples of orcs in the world that actually use biomimetics technology. Biomimetics itself was considered to be one of the very effective ideas to connect STEAM education with everyday and social life. Furthermore, although biomimetics belongs to the category of bioengineering in terms of academic classification, a wide range of knowledge such as biology, chemistry, physics, geology, mathematics, society and economics is required at the same time when studying this subject in practice. Therefore, even if the education using biomimetics is a biology unit, its content is linked to other subjects. Finally, biomimetics is considered to be a type of large-scale exploration activity that can be carried out relatively easily, as research can be carried out using familiar organisms as models.

In particular, the perspective of harmony with and learning from the natural world, which is emphasised in religious traditions such as Taoism and Shintoism, is



・探究の過程は，必ずしも一方向の流れではない．また，授業では，その過程の一部を扱っても良い．
・小学校及び中学校においても，基本的には高等学校の例と同様の流れで学習過程をとらえることが必要である．

similar to the basic principles of biomimetics. As mentioned above, Taoism has recognised the wisdom of the natural world and the value of its imitation, and has taught that humans should learn from and be with nature. Biomimetics applies this ancient wisdom to modern technological development, with the aim of realising a more sustainable and harmonious society.

The process of problem-solving and exploration activities, which is widely practised in Japan today, is largely divided into four stages: setting the task, analysing information, organising and analysing, and summarising and expressing, and learning is considered to be a repetition of this cycle.

Biomimetic thinking can be considered as one application of such exploratory thinking. In biomimetics, it is said to be divided into six stages: 'design extraction', 'biological translation', 'discovery of biological models', 'imitation of nature' and 'invention of designs'.

The aim of this study was to clarify the following points when designing a biomimetics-based biological unit model that can be used in high schools.

① Based on the concept of STS education, this paper identifies teaching methods to promote understanding of how science, technology and society interact with each other.
② Allow students to identify the learning processes required in exploratory activities.
③ Clarify the reality of students' views and perceptions of nature and living organisms.

Fig. The learning process that should be emphasised to foster the development of qualities and abilities (extracted from Ministry of Education, Culture, Sports, Science and Technology (2018)).

This paper describes two parts of the research methodology exercise and problem statement using real-life examples of biomimetics.

6.1 Make them learn how to think about biomimetics research.

The basis of biomimetics is 'biomimicry'. The two essential aspects of biomimetics are (1) the extraction of the features of biological models and (2) the development of design concepts that reflect biological models. The aim is to identify the characteristics of organisms, investigate how biological models utilise these characteristics, and fully understand and explain the functions and strategies of organisms, using the following worksheets as practice for extracting the characteristics of biological models.

mechanisms and functions of the features of the biological model without resorting to biological terms. Also, draw an illustration of that design strategy.

surface of many mollusc shells. It is composed of about 95% inorganic minerals (calcium carbonate) and 5% organic matter (a mixture of proteins and polysaccharides, including chitinous substances). The inorganic minerals make the material hard. Although inorganic minerals are a very important component of the shell's supporting and protective structure, they also make the material brittle and relatively easy to break (artificial glass is an example of a brittle material).
Due to its special composition and structure, the nacreous layer has high toughness and is resistant to complete failure due to crack spreading. Higher toughness here means that more energy is required to fracture or break the material. The hard microscale mineral layers of the nacreous layer are "glued" together by the relatively soft nanoscale organic layer. This arrangement is similar to the staggered layers of bricks held together by mortar in a brick wall. When the nacreous layer cracks (e.g., due to predator attack), it immediately strikes the organic layer, which is more easily stretched than the mineral layer. The cause of the tendency of the organic material to stretch varies among different species of pearls: in some mechanisms, the fibers are wavy or folded and straighten out before they feel significant tension.

The overall effect is that the elastic organic layer deflects cracks and provides a path for energy absorption and dissipation. Cracks can be controlled and contained before they spread throughout the shell and cause severe damage. It may seem counterintuitive, but the incorporation of micro-scale weaknesses makes the entire material tougher on the macro scale.

Q1: Based on what you have learned from the excerpt, draw a drawing of a biological strategy.
Q2: Using the underlined words and phrases, write a "design strategy" that describes the key

The black-lipped mussel was used as a biological model for practice. The reason for this is that the organisms in the larger taxon (shellfish) are relatively familiar to students, but have easily recognisable characteristics, and because they are not familiar to them, they are unlikely to interfere with future activities. In actual classes, it is also possible to use models of organisms specific to the region and start with organisms that are familiar to the students.

As a point to note when carrying out this exercise. In learning this material, the aim is to make your own or your team's ideas easier to understand. The best way to do this is to learn how to draw out the biological strategies of a biological model and make them common knowledge within the team, for example by using a tree diagram or a whiteboard. In addition, in learning to think about biomimetics, it is important to know about previous biomimetics research and what kind of research has been done.

6.2 Raise a familiar problem and analyse the factors that cause the problem and the

environment that influences it.

Problem posing in biomimetics is an important step in generating solutions based on real-world problems and is a highly effective approach in inquiry learning and practical teaching. It can help students develop a deeper understanding of real-world problems and the ability to come up with practical solutions. This is the stage in which students identify what they care about and what they want to solve in everyday life and society, and determine their goals in subsequent activities.

The problem statement here is not about what to make or invent, but about understanding for whom, in what circumstances and for what purpose the invention needs to be made. It needs to be clear what problem you want to solve, what knowledge you need to solve this problem, what background you need to know and what other fields are relevant to this problem.

Here, it is important to distinguish between 'problems' and 'issues'. The final destination of a problem statement is to discover the issue, which is the specific action needed to solve the problem. To do this, it is necessary to raise the problem at hand, analyse the factors causing the problem and the influencing environment, and clarify where the challenge for solving the problem should be set. This chapter describes the process from posing the problem to setting the problem in the biomimetics inquiry class.

The first thing that needs to be done is to set up a problem or a 'goal to be achieved'. If there is something that concerns you in your daily life or society, you can organise the problem, but not all students are able to raise the issue easily. One way to raise the issue is to choose a familiar goal from those already raised on social issues such as the SDGs.

For example, a starting point could be to do something that leads to the achievement of SDG 3 'Health and well-being for all', where target 6 of SDG 3 is to 'By 2020, halve the number of deaths and injuries from road traffic crashes.' This is a topic that is familiar to high school students. Road traffic accidents are a familiar topic for high school students, and in 2022, in the ranking of causes of death by age published by the Japanese Ministry of Health, Labour and Welfare , 'unintentional accidents' ranked second as a cause of death among '15-19 year olds'. The total number of commuters who commuted to school by bicycle was 14.2 % of the total number of commuters in the 2020 Census . From this it would be possible to derive the problem of 'reducing accidents when commuting to school by bicycle'.

Once a broad problem has been found, the task is set from that problem. The scope of the problem needs to be adjusted so that it is not too broad or too narrow. Teachers' guidance is important in this area, as it is difficult for students to find just the right range of problems on their own. In a first exploration activity, it may also be important to revisit the problem from time to time and make modifications.

7. Future outlook

The aim of this paper was to develop a unit concept for inquiry-based learning that corresponds to the new educational guidelines available in both countries, as Japan and China set similar educational goals at the same time. The educational philosophy of traditional inquiry activities in both countries was investigated, and the importance of 'learning from nature' was set out. The part of the enquiry activity using biomimetics, the study of 'learning from nature', was elaborated in terms of exercises to make students understand the concept of biomimetics and the part of the activity in which problems are posed. In the future, we would like to look at this activity in more detail, discover the unique characteristics of inquiry in both Japan and China, propose inquiry activities that can only be done in those countries, and create modules that can be used when conducting biomimetics inquiry activities.

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