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Curriculum Development Based On " Period Of Integrated Studies " To Cultivate "STEAM Educational Skills" And Construction Of A Hybrid Validation System

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Abstract

In Japan, the government aims to promote "2021 Japanese-style school education,"[1] enhance STEAM education (Science, Technology, Engineering, Arts, and Mathematics)[2] and contribute to the SDGs through school education. The "the period for integrated studies" [3] in elementary, junior high and high schools is a symbolic subject and area that aims to achieve these goals, and "the period for integrated studies" is also offered in university teaching courses to train teachers who can teach in schools. The period for integrated studies" [3] is a symbolic subject and domain that aims to achieve these goals. Therefore, the purpose of this study is to develop a prototype curriculum for STEAM education that can be used both in university classes and school classes on "the period for integrated studies". The qualities and abilities to be cultivated in STEAM education that will be required in the future were organized as "STEAM educational capabilities," and were tentatively set as "three perspectives" and "three qualities and abilities" in concrete terms. In order to make these efforts effective, we constructed a hybrid verification system for verification and evaluation through external collaboration, and used it as a foundation for curriculum management.

In this report, we will discuss the derivation of "STEAM educational competencies" and the hybrid validation system.

Keywords ・SDGs STEAM education the period for integrated studies

1. Background of the study

Under the new Courses of Study fully implemented from the 2020 academic year, children who will live through an era that is difficult to predict are expected to "create new values that lead to individual and social growth with qualitative enrichment, driven by the diversity of each individual as a bearer of a sustainable society" (Ministry of Education, Culture, Sports, Science and Technology, MEXT, 2018), and learners are required to develop learner-centered learning with the aim of "realizing curricula that are open to society. Furthermore, MEXT aims to promote "Japanese-style school education in 2021,"[1] which is indicated in FY2021, to place more emphasis on connections with society, to realize the aims of the new Courses of Study, and to establish a policy of enhancing STEAM education[2], aiming to contribute to the SDGs through school education. These educations are required to clarify the qualities and abilities to be cultivated, and to develop them through inquiry-based learning. In school education, it is necessary to cultivate these abilities in subject education, but they must also be acquired in conjunction with "the period for integrated studies")[3].

In order to put these frameworks into practice and further cultivate these abilities in students, it is essential to first build the competence of the teachers in charge of the classes. At universities today, courses are being offered to train teachers who can lead "the period for integrated studies. Since this is a new subject that aims to connect to society, it must be demonstrated through collaboration among industry, government, and academia, and it must be made into an effective curriculum. In order to achieve this, not only internal evaluation by the implementing entity, but also verification and evaluation by external experts are required to implement curriculum management. Therefore, we have formed an organization consisting of external experts and aim to construct a hybrid verification system.

2. Purpose of the research

In order to promote STEAM education, it is necessary to establish the qualities and abilities that should be fostered in STEAM education in the future. This research aims to develop the qualities and

abilities to be fostered as "STEAM educational capabilities," to construct a teacher training curriculum based on the view of these capabilities, and to contribute to the SDGs in school education. We aim to develop an effective STEAM education prototype curriculum based on the teaching subject "the period for integrated studies" that can be used both in university classes and in the school setting.
The following are the three objectives of this report.
First, to clarify the process and basis for the derivation of the "STEAM educational competencies" to be established.
Second, we will present a draft curriculum model of "the period for integrated studies" that embodies the development of "STEAM educational competencies".
Third, we will clarify the concept and specifics of constructing a hybrid verification system.

3. Progress, Results, and Discussion

(1) Derivation of "STEAM education skills" to be developed
STEAM education is based on the integration and collaboration of subjects and disciplines, and emphasizes connections with society.
The trend of international views of qualities and abilities is represented by the OECD Future of Education and Skills 2030: "What knowledge, skills, attitudes, and values do today's students need in order to grow and open up to the world?" How can schools and classroom structures be designed to effectively develop these knowledge, skills, attitudes, and values? This is the question that needs to be constantly addressed. The project presents the OECD Learning Compass (Learning Compass) 2030, an evolving framework for learning that describes the future vision required for education in 2030. It "sets the direction for the wellbeing of individuals and society: the future we want" and states that it is an "evolving framework. As a "core foundation for learning," it states that "the key knowledge, skills, attitudes and values needed in 2030 are not limited to literacy and numeracy, but also include data literacy (the ability to use and analyze data) and digital literacy (the ability to use and analyze data)," as learners "move in a direction that will enable them to fulfill their potential. The key knowledge, skills, attitudes, and values needed in 2030 include not only literacy and numeracy, but also data literacy, digital literacy, mental and physical health care, and social-emotional skills. The competencies that will bring about change toward the creation of a better future that will demonstrate these skills include "the ability to create new values, take responsible action, and deal with conflicts and dilemmas that will shape the future.
There are various views of competency in Japan. As a framework for primary and secondary education, the view of ability at the stage of discussion on the preparation of the new Courses of Study, the abilities in the new Courses of Study are organized as "three pillars of qualities and abilities" (knowledge and skills; ability to think, judge, and express; ability to learn; and humanity) in consideration of domestic and international trends, consistency with the School Education Law, and other factors. In addition, the report also identifies four perspectives (knowledge and understanding, general ability, attitude and orientation, comprehensive learning experience, and creative thinking) as bachelor's abilities in terms of the qualities and abilities required of students upon graduation from college.
As for domestic research on the qualities and abilities of STEM/STEAM education, Arai (2018)[4] has a perspective that brings about changes in social structure, Kumano et al. (2018)[5] in their series of studies, a pedagogical perspective as science, technology, engineering, and mathematics education reform, Matsubara et al. (2017)[6] a cross-curricular perspective, and Isozaki et al. (2022)[7] , a Japanese-style STEAM literacy perspective through an international comparative study, and others.
In this study, we decided to base our study on the basic skills for working adults as indicated by Japan's Ministry of Economy, Trade and Industry as a concrete framework that is closely related to the connection with the real society in the near future and can serve as a foundation for an "ever-evolving framework.
Based on this, the required "STEAM education skills" were defined as "three perspectives" and "three qualities and abilities. Specifically, the "three perspectives" are: 1) for what (purpose) (problem solving, accomplishment of tasks, self-affirmation, social contribution, and innovation), 2) what (content) (awareness of and positive response to SDGs and Society 5.0), 3) how (methods) (making full use of the three qualities and abilities, implementation, and (3) How (how to reflect on the process of implementation by making full use of the three qualities and abilities, and remembering the spirit of further ingenuity and eco-friendliness). The "three qualities and abilities" are: (1) the ability to step forward (independence, action, spirit of challenge, ambition), (2) the ability to think things through (imagination, creativity, critical thinking, scientific inquiry, metacognition), and (3) the ability to work together (communication, negotiation, cooperation, social skills, ability to recognize others). We aim to further clarify these "scopes and sequences" and present a leading, innovative, and effective prototype

of "the period for integrated studies" as a foundational study in the teaching curriculum subjects in Japan.

(2) Curriculum concept of "the period for integrated studies" aiming at the development of STEAM educational skills

A proposed lesson plan for 15 lessons is shown in Table 1. Senior students provided learning support throughout the class, and students evaluated each other at two debriefing sessions (mid-term and final), along with evaluations by external experts.

Table 1: Plans for "the period for integrated studies" in FY2022

Number of classes	Main initiatives
	Prior to the start of all classes Pre-survey
1st-3rd	Explanation of contents
4th - 7th	Group activities
8th - 9th	Mid-term report meeting
10th -13th	Group activities
14th -15th	Final debriefing
	After all classes Post-survey

(3) Development of hybrid verification system

We will develop a hybrid verification system that verifies initiatives from multiple and multifaceted perspectives. This will be done by comparing and contrasting the results of the research and verification described in (2) above.

(1) Establishment of a verification committee

We will organize a verification committee consisting of about 10 researchers and practitioners in the field of STEAM education from educational administration, science and engineering, and faculties of education, with whom we have already established cooperative relationships.

(2) Activities of the Verification Committee

The following activities will be conducted in accordance with the objectives, and analysis will be attempted from specialized and multifaceted viewpoints.

● From the viewpoint of the connection between the view of qualities and abilities established and the developed curriculum, the validity of the initiatives was verified through direct participation in student practices and debriefing sessions (May-July) and through mutual exchanges including advice and evaluations.

●The curriculum was put into practice, and the results and issues were clarified at a workshop (August) and a symposium-style workshop (December).

4 Future plans

We will continue to examine the validity of the "STEAM educational competencies" based on the results of our analysis through repeated practice, and we also plan to conduct a more precise analysis of the development of students' STEAM educational competencies.

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