The educational effect of Inquiry-Based Learning that uses knowledge through Japanese Classics x *Monozukuri*(manufacturing)

Midori Ogita* [a], Keiko Eguchi[b], Miho Moriki, Mai Otsubo[d],
Miyu Kumazawa[e], Saori Tamada[f], Akane Mori[g]

[a]Dept. of Humanities and Social Sciences, NIT, Maizuru College, Maizuru, Japan
[b]Graduate School of Humanities and Social Sciences, Nagoya City University, Nagoya, Japan
[c]Dept. of Creative Engineering, NIT, Tsuruoka College, Tsuruoka, Japan
[d]Dept. of General Education, NIT, Sasebo College, Sasebo, Japan
[e]Dept. of General Education, NIT, Suzuka College, Suzuka, Japan
[f]Dept. of General Education, NIT, Toyota College, Toyota, Japan
[g]Faculty of Human Sciences, Kyushu Sangyo University, Fukuoka, Japan

*m.ogita@maizuru-ct.ac.jp

This study explores the educational effects of the "Japanese Classics x *Monozukuri* (Manufacturing)" initiative as a method of engineering education. The authors has been implementing an inquiry-based learning approach that integrates *Monozukuri* (hands-on creation and manufacturing) into Japanese classic literature education. Specifically, this initiative involves students creating and presenting visual materials using scientific and technological tools to deepen their understanding of Japanese classical literature. Findings indicate that this approach is particularly effective for science and engineering-oriented students, many of whom exhibit a strong aversion to the Japanese language, especially classical texts. The method promotes proactive and creative engagement with learning material that they would otherwise find inaccessible or uninteresting. This initiative was developed in response to the changing landscape of classical education. In 2016, Japan's Ministry of Education, Culture, Sports, Science and Technology (MEXT) identified a key challenge: Japanese classic education lacked a perspective that encouraged students to actively enjoy and appreciate the language and culture inherited by the Japanese people, resulting in low motivation to learn. Supporting this observation, annual surveys conducted at Tsuruoka KOSEN consistently revealed overwhelmingly negative attitudes among new students toward Japanese classical literature. At the junior high and high school levels, Japanese classic education has often taken the form of exam-focused, rote learning that fails to convey the intrinsic interest and value of Japanese classic literature. To address this issue, the "Japanese Classics x *Monozukuri*" initiative was introduced. In the 2024 academic year, first-year students at three KOSEN colleges—Tsuruoka, Maizuru, and Toyota—participated in practical activities combining Japanese classical literature with *Monozukuri*. A post-class survey was conducted across all three schools, with 509 student responses collected. Results showed that 96% of students reported an increased interest in Japanese classic literature through the initiative. Furthermore, 92% noted a heightened interest in specialized subjects and technology. 231 students responded that they have things they would like to try if they had more knowledge or technical skills. Additionally, 95% of students believed that the "Japanese Classics x *Monozukuri*" program would benefit their future learning at KOSEN. These results suggest that the initiative effectively increases students' interest and engagement in both Japanese classic literature and engineering, encouraging them to apply the principles, methods, and technologies they learn in their specialized fields. Moving forward, the initiative can further enhance students' learning in technology by building on their engagement with Japanese classic literature. It is believed that, moving forward, this initiative can further enhance its educational effectiveness with the cooperation of specialized faculty members.

Keywords: *Classics, Monozukuri, visual materials, Inquiry-Based Learning, Japanese classical literature*

Introduction

In a globalizing society, being able to explain about one's own culture leads to establishing one's own identity. The starting point for cross-cultural exchange is to know one's own country, Japan. Being able to answer confidently about Japanese culture, history, customs, and values is the foundation for accepting other cultures. It is essential learning for KOSEN that aim to cultivate human resources who can play an active role globally, and it is a quality that students should possess.

This study practically examines the possibility that classical education based on "Japanese Classics x

Monozukuri" contributes to the cultivation of global human resources and engineering education. This paper clarifies that classical education deepens the understanding of national culture and stimulates interest in engineering through the analysis of the questionnaire results and practical examples of the common program by three schools, Tsuruoka KOSEN, Maizuru KOSEN, Toyota KOSEN.

Materials and Methods

1. *Original textbook "YUI no KOTEN"*

In March 2024, the Society for Classical Education of KOSEN published a textbook called "YUI no KOTEN." Japanese classic literature has been adapted, illustrated, and dramatized in various forms through they have been enjoyed by people for a long time. Conventional textbooks select works in consideration of fixed teaching materials and grammar learning and are not suitable for understanding about how to enjoy and cultural activities. "YUI no KOTEN" selects Japanese classic works based on the keyword "connection" "adaptation" and arrange them. Therefore, it is possible to understand how works are enjoyed by people and how they have changed up to the present day.

Figure 1. The original textbook "YUI no KOTEN."

Three schools, Tsuruoka KOSEN, Maizuru KOSEN, and Toyota KOSEN, used "YUI no KOTEN" as their textbook to study Japanese classic literature in the first semester of the first year. Although the number of class hours varied due to each school's distinct curricula, teachers introduced largely common works and classes were structured so that students could become familiar with various classic works.

In the second semester, we assigned the students the task of "Japanese Classics x *Monozukuri*," and the students were required to make presentations introducing classic works. The students selected works on their own initiative, centering on the works published in "YUI no KOTEN". In order to make presentations that convey the interest and interpretation of the works, the students were combined with the techniques of *monozukuri*, which they learned at the College of Technology.

In this paper, three examples of presentations on the subject of "*Kuruma arasoi*" (*The Tale of Genji*) published in the textbook are discussed.

2. *What is "Kuruma arasoi"?*

The Tale of Genji is a classic of Japanese literature and was written in the early 11th century by Murasaki Shikibu, a lady-in-waiting and middle-class noblewoman. Japanese students always learn about it in their school education. It is a lengthy narrative that describes the life of Hikaru Genji, who was born as a son of the emperor, full of love and power. High school curricula often cover scenes of Genji's birth and his encounter with Murasaki, the girl who would later become Genji's beloved wife. However, there are other famous scenes in *The Tale of Genji* that have produced many secondary works. One of them is "*Kuruma arasoi* (Battle of the carriages)."

When Genji was 22 years old, there was an incident at the Aoi Matsuri festival. Lady Aoi, Genji's legal wife, and Rokujō, Genji's mistress, came to the festival to watch Genji participate in the festival procession. Lady Aoi's retainers forcibly evicted other carriages to secure an advantageous spot from which to view the festival. Among them was the carriage Lady Rokujō was riding. Her carriage was damaged in the fight with Lady Aoi's party, and she felt very ashamed of it. Lady Rokujō's jealousy and resentment turned to Lady Aoi, who was pregnant, and as a result, Lady Aoi died immediately after giving birth.

This episode is well known among people in *The Tale of Genji*, and based on this episode, Noh play "*Aoi no Ue*" and various designs were created. The diverse development of this episode in later years seems to have stimulated the imagination of students in modern Japan. Next, we introduce the practical examples of students' manufacturing on the theme of "*Kuruma arasoi*" in each school.

3. *Case of Tsuruoka KOSEN*

In Tsuruoka KOSEN, the subject was carried out for creative engineering department 1 year (160 persons). Students are assigned to specialized courses from the second year, and in the first year, all students learn the basics of four specialties: machinery, electricity, electronics, information, and chemical biology.

In the class, he read the Aoi chapter of *The Tale of Genji*, watched the Noh play *Aoi no Ue* and tried to understand the contents deeply by comparing the expressions. In the practice, a presentation was made in which an ox-drawn carriage that appears in "*Kuruma arasoi*" was reproduced. It is possible to know what an ox-drawn carriage is by looking at a collection of materials, but the ox-drawn carriage is not a familiar vehicle, so it does not feel real.

So the students used the crank mechanism they had learned in mechanical design to create a moving oxcart, not just a model. At first, the students worked on the ox-drawn carriages because they wanted to make use of the knowledge they had learned, but as they made them, they became more interested in Japanese culture, such as the types and decorations of ox-drawn carriages.

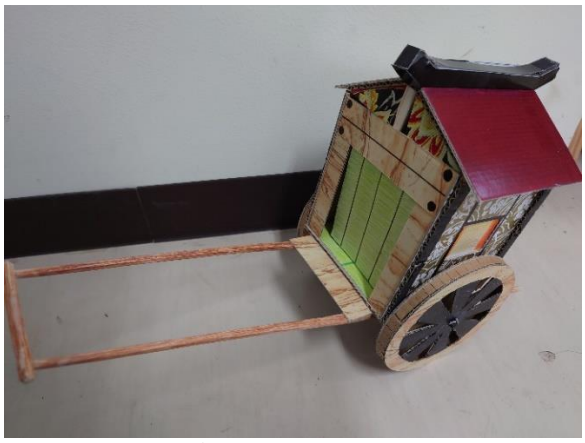

Figure 2. The design of the carriage model.

4. Case of Maizuru KOSEN

At Maizuru KOSEN, there are four departments: Mechanical Engineering, Electrical & Computer Engineering, Control Engineering, and Civil Engineering & Architecture. First-year students take general education courses—including Japanese classics—in mixed, cross-department classes. In Japanese Classics, students give presentations that explore Japanese classic literature by focusing on word usage and passages. Since the mid-term examination require a written statement of purpose and project plan, many students gravitate toward topics that allow for experiments or demonstrations.

This paper highlights one such presentation, which involved a 3D reconstruction and analysis of the *Kuruma Arasoi* (Carriage Battle) scene from *The Tale of Genji*. A group of three students focused on a painting of the scene (Fig. 3), in which one leg of a *shiji*—a footstool used to stabilize a carriage—appears broken. They investigated the possible cause of the break.

Figure 3. Tosa Mitsuyoshi(17th Centuries) *Aoi Chapter from The Tale of Genji*, Kyoto National Museum (ColBase (https://colbase.nich.go.jp/)).

The students proposed two hypotheses: one, that the carriage was damaged in a collision after being pushed aside by another; and two, that drunken young men at the Aoi Festival caused a disturbance that led to the damage. Using Unity to simulate both scenarios (Fig. 4), they concluded that the latter explanation was more plausible.

From the perspective of the "Japanese Classics x *Monozukuri*" approach, the students' analytical thinking was remarkably creative and insightful. Although they

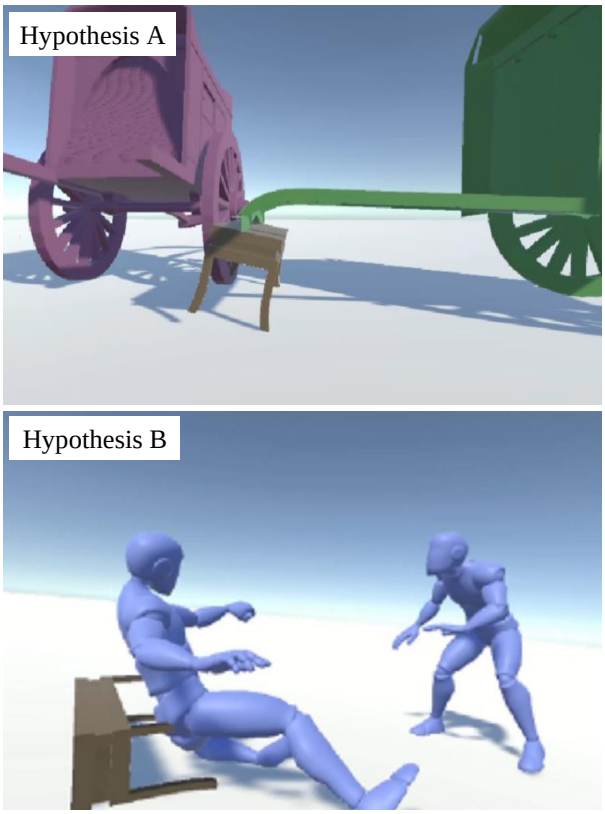

Figure 4. Part of the simulation video of Hypothesis A and B by Unity.

based their analysis on a painting produced roughly 600 years after the original text, and their method diverged from conventional literary analysis, their interpretation opened a new perspective. Their reading suggests that the painting emphasizes the aggression of an intoxicated young man rather than the physical impact of a carriage crash. This fresh viewpoint offers potential contributions to the study of *The Tale of Genji* as represented in later visual art.

5. Case of Toyota KOSEN

In Toyota KOSEN, "Japanese Classics x *Monozukuri*" were carried out in five departments, Mechanical Engineering, Electrical and Electrical Engineering, Information and Computer Engineering, Civil Engineering, Architecture. As shown in Table 1, the students' works showed the characteristics of the department to which they belonged.

Table 1. Characteristics of student's works by their department.

Dep	Charactaristic
M	Create something that appears in a classic work
E	Use the circuitry you just learned
I	Use AI and AR Technologies
C	On-site research of places in classic works, Use a map app
A	Reproduction of buildings and furnishings from classical works

This time, I would like to introduce the work of the student team of Department E. Their work is the carriage Lady Rokujō was riding in "*Kuruma arasoi*." The title of the work is "Let's strengthen Lady Rokujō's carriage." They were fans of Lady Aoi and thought about how to avoid her death. They thought that this tragedy could be

avoided if Rokujō's carriage was not broken during the battle of carriages. So they decided to strengthen Rokujō's carriage. Then, where and how should the carriage be strengthened so that it won't break? They often read *The Tale of Genji* and took note of the expression "*oshiorare*(pushed and broken)." Based on this description, they guessed that the carriage was broken by an instantaneous impact, and decided to improve the carriage to one with superior impact resistance. They assume that the force of 1 adult pushing the carriage was 755 N and the Lady Rokujō's carriage was pushed by 3 adults. Furthermore, the calculation was carried out considering the acceleration due to gravity and the size of the model carriage. As a result, the goal of this study was to ensure that the model carriage would not be damaged if dropped from a height of 0.865 m. To improve the shock resistance of the carriage, they devised 3 points.

1. The wheels were covered with rubber.
2. Mass dampers were added.
3. The joints were made stronger by *Sashimono* Japanese traditional technique.

What is interesting about these improvements are that it incorporates not only the modern techniques of rubber and mass dampers, but also the traditional Japanese technique, *Sashimono*. Fig. 5 shows the design of the carriage model produced by 3DCAD, and Fig. 6 shows the finished product of the carriage model. The completed model carriage was dropped from the side and diagonally, respectively, and the strength test was carried out, and the model passed the test.

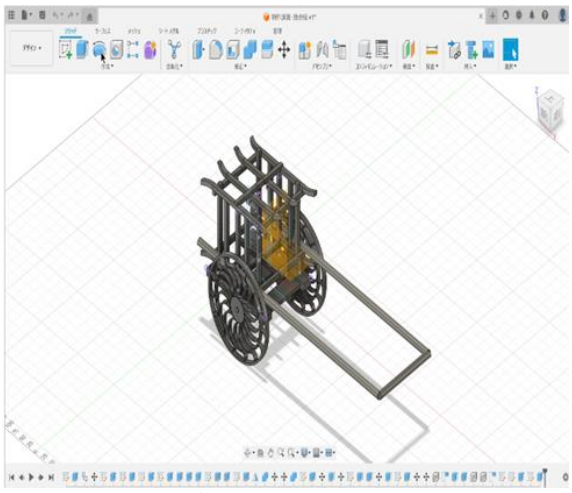

Figure 5. The design of the carriage model by 3DCAD.

Figure 6. The completed carriage model.

Results and Discussion

1. *Questionnaire analysis*

From January to February 2024, a questionnaire survey was conducted with students at 3 schools, Tsuruoka, Maizuru, and Toyota, which held presentations on Japanese classics and manufacturing. The number of responses was 509, with a response rate of 94.6%. The breakdown is as follows.

Table 2. Number and percentage of questionnaire responses.

	Number of responses	Number of students	Response rate
Tsuruoka	158	160	98.8%
Maizuru	149	167	89.2%
Toyota	202	211	95.7%
Total	509	538	94.6%

The questionnaire asked Q.1 to Q.5 about the use of knowledge and the growing interest in Japanese classics and expertise in this assignment.

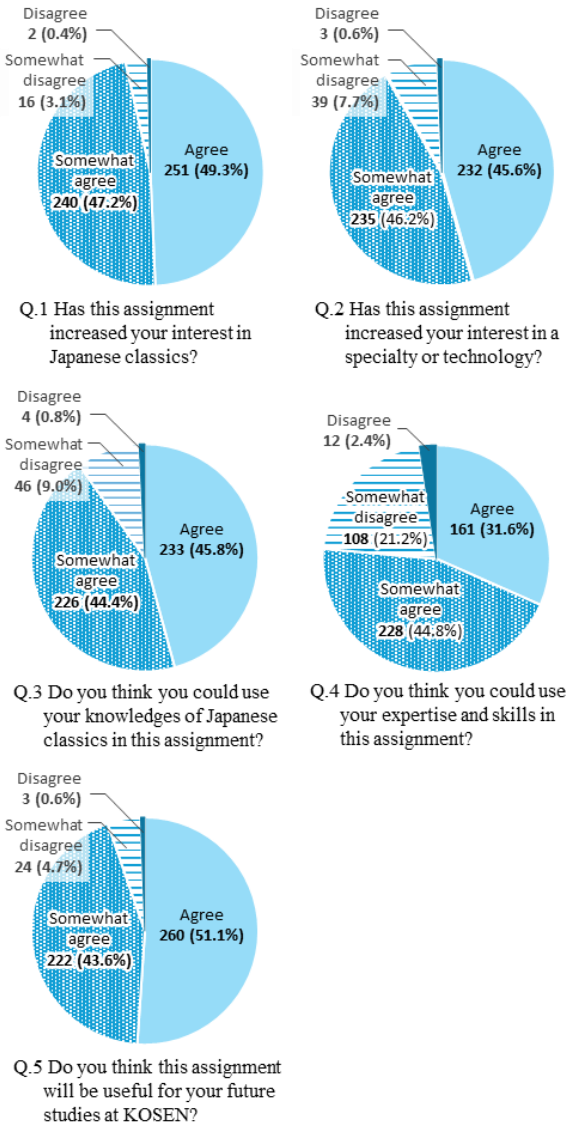

Figure.7. Results of a questionnaire after class of "Japanese Classics x *monozukuri*".

As shown in Figure7, 96.5% of the students responded that their interest in Japanese classics increased or somewhat increased through this assignment (Q.1). The percentage of students who were able to utilize their knowledge of the Japanese classics through this assignment was as high as 90.2% (Q.3).

To the Q.4, “Do you think you could use your expertise and skills in this assignment?” 23.6% of students answered “disagree” or “somewhat disagree,” which was higher than other questions. It was partly because first-year students were not so familiar with their fields of expertise, and because they were allowed to make materials from literature research methods to make it easier to work on. Therefore, even if they could not make the most of it in their presentations, it can be seen from Q.2 that their interest in the expertise is surely increasing, and from Q.5 that the students feel that this assignment is useful for their learning at the KOSEN. When asked why they answered “agree” or “somewhat agree” in Q.5, it was revealed that they had gained confidence from the experience of doing their own planning, research, analysis, and presentation by actively using the expertise while researching on their own what they did not understand. In addition, some students answered about the importance of sharing roles in group work and making presentations clearly.

2. Comment analysis

What was common among the three cases introduced in this article is that the students actively tried to understand classic works through this project. The students at Toyota KOSEN stated in an after-action questionnaire:

“Through careful reading of classical works, I learned that there are various theories on the interpretation of classic works.”

“When I make something based on a classic work, I look for the information necessary to make a work from the details of the story, so I can deepen my reading of the story.”

It was also clear that the students' deepening understanding of the story made them feel familiar with the world of classics as they do today. Many other comments were also received.

In terms of classical education, it was confirmed that the active learning style, in which students voluntarily select works and examine them, increased their motivation to learn and deepened their understanding. In terms of engineering education, the first-year students had few opportunities for practical training and projects, and it was confirmed that this task was a good opportunity to practice the technology they wanted to use. In addition, the students who did the project with more than one person seemed to have a good opportunity to understand the difficulty of accomplishing a project in a group and to think about how to make it work.

Conclusions

This study revealed that the attempt of “Japanese Classics x *monozukuri*” has an good effect on students' learning in both classical and engineering education.

Finally, future issues and prospects are described.

One of the issues is technical support for students when they work on tasks. Even if students have a technology they want to use (for example, a 3D printer), they may have to give up because they do not have the equipment or do not know how to use the equipment. It is desirable to cooperate with faculty members of specialized departments and receive technical support when they work on tasks.

Next, the future prospect is described. We plan to hold “Japanese Classics x *Monozukuri* contest," a joint KOSEN manufacturing contest in December this year. By providing opportunities to connect students from different KOSEN who have worked on the same task using the same textbook, we aim to further improve students' motivation and technical skills. The contest can be entered regardless of grade. This study targeted first-year students, but we plan to further analyze the educational effects in other grades.

Acknowledgements

This research was supported by KOSEN Research Network Formation Support Project.

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