

Refining the Art of Judgment Education: Evaluation of an educational case study on making judgments about the pros and cons of COVID-19 vaccination during the pandemic

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ABSTRACT¹

We discussed the form of education that fosters rational judgment based on the selection and prioritization of a large amount of information. Specifically, we developed a lesson plan for fostering judgment skills focused on the theme of the pros and cons of COVID-19 vaccination for prevention. We sorted out the twelve requirements for classes from three perspectives: education for fostering judgment, risk education, and critical thinking education. Based on the extent to which the twelve requirements were reflected in the course design, the course was evaluated on two aspects: "A: education that promotes subjective judgment without scientific or logical errors" and "B: education to achieve desirable judgment through communication." As a result, it was evident from the questionnaire survey evaluation that B was sufficiently achieved. On the other hand, the effectiveness of A resulted in different outcomes between student questionnaire survey evaluations and instructor assessments of the reports. In other words, while the student survey indicated sufficient achievement, the instructor evaluation indicated that it was not sufficient. From this, it is inferred that some simplification is important at least as an educational practice in this university.

Keywords: Education to Foster Judgment Skills, COVID-19, Critical Thinking, Risk Education, Education for Decision Making

1. INTRODUCTION

In modern society, we are exposed to a vast amount of information and are required to make judgments based on our understanding and selection of that information. To make a judgment that aligns with our desired results, we now need to understand a significantly larger amount of information than before, to choose or discard information and then to make decisions. Artificial intelligence (AI),

such as ChatGPT, can help in information-gathering and, in some cases, its selection. However, individual judgment, which includes personal subjectivity, naturally requires each individual's ability and cannot be replaced by AI. Moreover, since AI is now expected to replace more human roles, the ability to make appropriate judgment is likely to be increasingly valued as a human role that is not so easily replaced by AI.

Education that fosters rational judgment based on the selection and evaluation of large amounts of information is not well developed today. Since the easiest form of judgment involves choosing between two options, our focus will be on educating about such binary scenarios. Some approaches to making decisions in such cases have been demonstrated by one of the authors, Kusumi [1]. While there is no single correct method for such approaches, the methods proposed by Failing et al. [2], Hammond et al. [3], and Quist et al. [4], as well as Kusumi's method, generally agree. These authors express nearly the same ideas, though with different order and emphasis.

In exploring educational methods centered around making decisions between two options, we have designed and published a judgment education program that focuses on the topic of the pros and cons of vaccination, using the COVID-19 pandemic as the subject matter. This program fosters the ability to make rational judgments based on the selection and evaluation of large amounts of information. The aforementioned approach to judgment can be described as an educational method that specializes in organizing information, particularly to enhance the understanding of the pros and cons of choices. The aim of this paper is to evaluate the effectiveness of this course, identify its limitations and potential, and discuss the future direction of judgment education.

¹ Yasukazu Hama proofread this article as a peer editor, and Kevin Berkowitz proofread it as a freelance English language editor.

2. THE OUTLINE OF THE PROPOSED EDUCATIONAL CONTENT

We discussed the requirements for the desired educational approach from three perspectives: judgment education, risk education, and critical thinking (CT) education. Here are the twelve requirements we extracted from the discussion:

- 1) Foster the ability to make appropriate choices from large amounts of complex information
- 2) Address issues that present binary choices
- 3) Teach an understanding of risk and risk comparison
- 4) Foster an understanding of uncertainty
- 5) Handle topics that absolutely require judgment
- 6) Foster risk communication skills
- 7) Foster expression and logic
- 8) Foster the ability to minimize bias
- 9) Foster trade-off understanding
- 10) Foster natural scientific literacy
- 11) Foster critical thinking (CT) skills
- 12) Make efforts to create effective meta-critical-thinking (MCT) skills.

We designed and implemented the course to meet the twelve requirements. Details are documented in Kusumi et al. [5], so here we report only the essential elements necessary for the evaluation.

The content of the class centers around teaching a "Simple Story" and a "Detailed Story" that could serve as prototypes for the logical structure used to evaluate the pros and cons of vaccination. The main focus of the class is to allow each student to build their own argument and refine it through discussion. As a prerequisite for teaching the "Simple Story" and "Detailed Story," we taught students the way to think about risk and risk comparison.

The "Simple Story" involves calculating the risk of death from COVID-19 and the risk of death from the vaccine, and making a judgment about the vaccination based on the comparison of these values. While omitting the detailed explanation as described in Kusumi et al. [5], it shows that the death risk from COVID-19 is estimated to be between 2-35 and the death risk from the vaccine is estimated to be between 0.1-2. Based on this, it was considered that getting vaccinated is better than not getting vaccinated.

On the other hand, the "Detailed Story" is more cautious in judging the necessity of vaccination, taking into account the uncertainty of the underlying assumptions of the "Simple Story." The "Detailed Story" explains various uncertain factors from the "Simple Story" and has students themselves think about what other uncertain factors exist. Based on these findings, even if the quantitative assessment in the "Simple Story" is highly reliable, it is not necessarily a perfect decision to endorse vaccination based solely on the "Simple Story." This explanation takes into account the uncertainties and limitations of the "Simple

Story" approach. In other words, the "Detailed Story" added an explanation that because of many uncertain factors, it can be difficult to make a judgment, and a negative judgment regarding vaccination cannot be considered a mistake.

The actual class was conducted in the course "Environmental Science B" at Chukyo University. We taught the same content in four classes per week of "Environmental Science B" at Chukyo University. Out of the 15 sessions of 90 minutes each, six sessions were dedicated to the actual class. In the first class, the focus was on teaching the previously-mentioned risks and the concept of risk comparison. In the second class, the focus was on teaching the "Simple Story" and the "Detailed Story." In the third class, the focus was on developing and refining individual arguments for and against vaccination. In the fourth class, we conducted group debates in teams based on the arguments each student had built and polished in the previous classes, further promoting a deeper understanding of the topic. In the fifth class, based on the arguments each student had polished in the debate during the fourth class and turned into a written report, the students checked and reviewed each other's reports. To make the classes more effective, we minimized lectures and instead used cooperative learning techniques. For reasons mentioned later, an additional sixth class was held to address areas of insufficient comprehension identified through the evaluation of the submitted reports.

In the sixth class, we presented typical arguments both for and against vaccination to serve as examples of possible stances on the topic. One argument in favor of receiving vaccination is that "based on a simple comparison of the risk of death, it can be said that receiving the vaccine is preferable. Quantitative risk assessment cannot make definitive judgments due to uncertainties such as unknown future circumstances, but organizing currently available information leads to the conclusion that there is no better overall judgment than this." The example of an argument stating that it is better not to receive the vaccine is as follows: "Even though a comprehensive judgment based on a "Simple Story" of comparing the risk of death can be considered valid, focusing on the subjectivity of vaccine side effects and prioritizing uncertain circumstances cannot refute the idea that not receiving the vaccine may be better." I also said these are just some examples of answers from the second class, and there could be other types of correct answers.

3. TWELVE REQUIREMENTS AND TWO EVALUATION PERSPECTIVES

To evaluate education that fulfills the twelve requirements outlined in chapter 2, we identified two perspectives that reflect these requirements: A) "Education that promotes subjective judgment without scientific or logical errors" and B) "Education to achieve desirable judgment through communication."

Of the two perspectives, the first one, A, reflects requirements 1, 2, 3, 4, 5, 8, 9, and 10.

First, requirement 1 was a requirement to be included by the instructors during the design phase. Since requirement 1 was itself difficult, the instructor performed it on behalf of the students, and it was an important premise for the framework of perspective A. Requirement 2 was originally an important requirement for designing a relatively simple framework for education aimed at fostering judgment skills. And it was also an important requirement for constructing the framework of A. In other words, it was originally a requirement that needed to be fulfilled when designing the course. Requirement 3 was also important for A's "scientifically correct" judgment. Regarding requirement 4, the instructor clarified all aspects that could be made clear and organized the uncertain elements into a form that requires individual judgment based on personal preference. By doing this, the "understanding of uncertainty" required was made in a form that did not require specific situations. Therefore, requirement 4 was an important requirement for deriving A's scientifically accurate judgment. Requirement 5, just like Requirement 2, was an important requirement for constructing the framework of A, and it was a requirement that needed to be fulfilled when designing the course. Requirement 8 was also an important requirement as it helped to build the framework of A by fulfilling it. Requirements 9 and 10 were also important in the same way.

On the other hand, the second perspective, B, succinctly reflects requirements 6,7,11, and 12.

Requirement 6 is indeed an important element of B in this course. The same applies to requirement 7. This course is inherently important for demonstrating critical thinking ability, and requirement 11 is an element of B. Requirement 12 is a slightly different element, but it is also a B-element in the sense that it is a requirement to facilitate smooth communication.

Based on the above, in this paper, we will evaluate this course from two perspectives: A and B.

4. EVALUATION OF THE TEACHING PRACTICE

Perspective A: Education that promotes subjective judgment without scientific or logical errors

A questionnaire survey was conducted after the classes. A total of 71 students took the course, and for the debate, the number of participants on the affirmative and negative sides was adjusted to be equal. As a result, some students conducted debates taking a position that was different from their own. The number of students who responded to the questionnaire survey was 57. A six-point Likert scale was used in the questionnaire. The option that most closely corresponded to the question received a score of 6, and scores decreased in one-point increments for each subsequent option. For example, "Strongly Agree" or

"Completely Satisfied" would be given a score of 6, and "Strongly Disagree" or "Completely Dissatisfied" would be given a score of 1. The results of the questionnaire obtained in this way are summarized in Table 1.

In t-tests, a meaningful numerical value (threshold) for comparison is required. Therefore, for the overall educational effect, a threshold was considered assuming that the respondents followed a standard normal distribution (refer to Figure 1).

In the case of the standard normal distribution, the mean is 0 and the standard deviation is 1, and 68.27% of respondents fall within the range of -1 to 1. If x is less than -1, it was judged as "low", and if x is greater than 1, it was judged as "high" score. Furthermore, since 95.45% of respondents fall within -2 to 2 in a standard normal distribution, we judged that a score below -2 corresponds to "very low" and a score above 2 corresponds to "very high".

Table 1. Results of questionnaire survey on judgment ability

Highest score: 6 Median:3.5 Lowest score: 1	Were you satisfied enough with your own judgment?	Do you think you could explain the validity of your judgment adequately enough to others?	Do you think your ability to compare risks has improved by taking this class?
Average	4.61	4.30	4.82
standard deviation	0.90	0.78	0.89
t-test result	*Statistically significant at the 1% level *high	*Statistically significant at the 1% level *high	*Statistically significant at the 1% level *high

The educational effectiveness questions were scored on a scale ranging from 1 to 6, with a median value of 3.5. Therefore, we divided the range as shown in Figure 1, set a threshold, and used t-tests to determine how significantly lower or higher the average score was for each question.

As shown in Table 1, all three questions, namely "Were you satisfied enough with your own judgment?", "Do you think you could explain the validity of your judgment adequately enough to others?" and "Do you think your ability to compare risks has improved by taking this class?" received significantly "high" evaluations. The results of the t-test were also high. Based on the students'

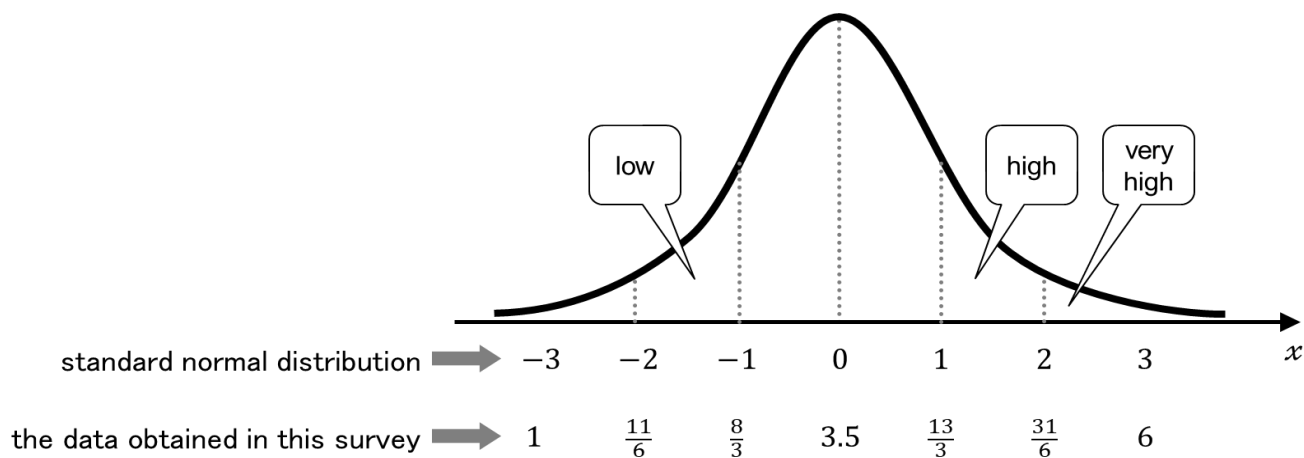


Figure 1. Correspondence of t-test values in this study to standard normal distribution

own evaluations, their ability to compare risks improved and they were satisfied enough with their own judgment.

Next, we conducted an evaluation from the perspective of the instructor. After the fifth class, one of authors assigned a report that required students to discuss their views on the "pros and cons of COVID-19 vaccination." The students were asked to choose whether they thought it was better to get vaccinated or not, and then list their reasons for their decision on the report form.

Fifty-four students submitted the report, but few of them were able to provide "subjective judgment without scientific or logical errors" with appropriate reasons. From the instructor's perspective, it was not yet possible to achieve the goal of providing education that helps students make subjective judgments without scientific or logical errors. The effectiveness of such a course is influenced by the level of the university that offers the class. At Chukyo University, a mid-tier private university, because of the many students who are weak in the field of science, technology, engineering, and mathematics (STEM), the abilities to make scientific or logical judgments are lacking in the first place. In this context, it seems that despite the challenges, education is being provided and many students feel they have made significant progress, although we as educators feel it is not sufficient.

In response to results noted above, an additional explanatory session was added, which was held in the sixth class. The questionnaire survey was conducted after this session. One possible factor for the higher self-evaluations compared to external evaluation could be attributed to this additional session.

From the instructor's perspective, this course did not achieve sufficient effectiveness until the fifth class, according to external evaluation. However, considering the high self-evaluation after the sixth class, one of the reasons for the higher self-evaluation may have been the effect of the supplementary explanations provided in the sixth class, even if the level of achievement was not as high as the instructor's goal. There are two possibilities: one is that the supplementary explanations provided in the sixth class were effective, and the other is that even though the students did not achieve the level of education the instructor aimed for, they still felt a sufficient educational effect. It is unlikely the sixth class had no effect at all, so it is reasonable to consider both possibilities.

From this point on, at least in the case of Chukyo University, education with more realistic goals should be implemented. The goal of the course discussed in this paper was quite difficult, and it was found that courses with lower-level goals are needed in order to achieve it.

Perspective B: Education to achieve desirable judgment through communication

This perspective is aimed at confirming whether communication within the class contributed to desirable judgments, so it was difficult to obtain external evaluations, and therefore only self-evaluation results were presented.

We conducted a questionnaire survey using the same method as in the previous section in the same place. The questionnaire survey results obtained are summarized in Table 2.

All seven items in the table received significantly high evaluations. The results of the t-test were also high. It was found that communication within the class significantly contributed to desirable judgment.

Table 2. Results of questionnaire survey on classroom communication and judgment

Highest score: 6 Median:3.5 Lowest score: 1	Did the preparation for the debate serve as an opportunity to gather various information on COVID-19?	Do you think your preparation and participation in the debate increased your knowledge about COVID-19?	Did writing down your thoughts during debate preparation help you organize your ideas?	Did having others point out the issues with your own opinions help in summarizing your own opinions?	Did you find it difficult to properly assert your own opinions?	Were you able to provide constructive criticism to the other person's opinion?	Were you able to modify (adjust) your own opinion by listening to the opinions of others?
Average	5.19	5.19	5.09	5.40	5.02	4.00	4.42
standard deviation	0.88	0.81	0.76	0.68	0.81	0.73	0.80
t-test result	*Statistically significant at the 1% level *high	*Statistically significant at the 1% level *high	*Statistically significant at the 1% level *high	*Statistically significant at the 5% level *very high	*Statistically significant at the 1% level *high	*Statistically significant at the 1% level *high	*Statistically significant at the 1% level *high

Discussion

In recent years in Japanese education, it has become increasingly difficult to conduct education in large classrooms where students' logical errors in what they express are pointed out and corrected. This is because students have become more sensitive to criticism and may file harassment complaints, and because the university administration tends to respect students' opinions to the fullest extent possible.

Considering these circumstances, we have been exploring an education approach to promote judgment based on communication among students. This includes our requirement 12 as well. This educational practice, which promotes judgments based on such communication, can be considered successful overall, as described in the previous section. On the other hand, as mentioned in the previous section, the level of educational effectiveness achieved by this class was insufficient, at least according to external evaluation.

There are a couple of things that can be done to enhance education effectiveness. First, teach challenging topics over an extended period of time, and second, refine the teaching methodology of the course. Although the subject matter varies, I, as the author, have repeatedly assessed the application of the techniques employed in this course, and I have implemented several enhancements since the design phase of the trial version of this course several years ago. Further refinements of the teaching methods are still being considered.

One could argue that the subject matter may have been overly challenging, and for this style of education, it is important to allocate additional time and develop an

educational program that is divided into smaller parts to meet various requirements.

5. CONCLUSION AND SUMMARY

First, according to self-evaluations by the students themselves, the education introduced as a whole has yielded generally positive results. This course has achieved sufficient results in "education to achieve desirable judgment through communication", and sufficient results have also been achieved in "education that promotes subjective judgment without scientific or logical errors".

Second, according to external evaluations by instructors, the level of achievement in "education that promotes subjective judgment without scientific or logical errors" was insufficient. Therefore, some kind of effort, such as allocating more time for explanation and discussion, or simplifying certain aspects of the course content, would be important in improving the educational practice at the target university.

On the other hand, it is still important to educate university students -- future decision-makers in society -- in developing rational judgment based on the selection and evaluation of the vast amounts of information available in contemporary society. Today, when AI such as ChatGPT is advancing, the consideration of educational practices that enable individuals to make decisions and act based on their own thinking and judgment is just beginning. It is my hope that this paper will serve as a catalyst for the development of such judgment-based education.

6. ACKNOWLEDGMENT

We would like to express our sincere gratitude to our peer reviewers, Mrs. Traci Butler Carroll (University of North Texas) and Prof. Yu Matsuno (Meiji University).

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