Original article

A Future Scenario-Making Approach as an Instructional Method in Planning Education: The Japanese Context

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Abstract: This study developed an instructional method for planning education based on a future scenario-making approach for a first-year course at a Japanese university. In environmental policy-making, such as that regarding climate change, energy use, community development, and so on, a multi-collaboration and planning approach was implemented to promote United Nation's Sustainable Development Goals (SDGs). On the other hand, planning education methodology in the Japanese context has not yet been sufficiently discussed. Based on the discussion in the European context and existing research, this paper focuses on a future scenario-making approach as an instructional method in planning education. For the research process, mini-lectures and group discussions were conducted in two lessons with three different classes, and two surveys, a worksheet analysis, and interviews were conducted with the participants. The results of this study implied the need for the following educational design in planning education: (1) to direct the students' attention to the mitigation of and adaptation to possible negative future events and scenarios, (2) to promote multilateral consideration using self-checking of the students’ homework and consideration of future events and scenarios, and (3) to stimulate critical thinking on the basis of (1) and (2).

Keywords: Planning Education, Future Scenarios, Future Predictions, Network Analysis

INTRODUCTION

National/local governments and communities need to prepare for climate change by making plans for climate change mitigation and adaptation. Community reformation is being planned in Japanese municipalities because of the country's aging and declining population. Furthermore, in urban areas of Japan, policies are being implemented to reduce the isolation of elderly people. The social implementation of artificial intelligence and internet of things (AI/IoT) is also a large factor affecting future society (such as optimization of the transportation system by unmanned aircraft and autonomous car and minimization of the energy use by IoT based electronics, see also METI (2015), Takeuchi (2017)). In situations where natural and social factors are rapidly changing, planning approaches are becoming increasingly important tools in the creation of directions and solutions at the local, national, and global levels. On the other hand, there are few educational programs in Japanese higher education that teach planning theory and practice.

In Europe, the framework of planning education has been shared based on international discussion, and each country has enacted its own planning education guidelines (Frank et al., 2014). The Bologna Declaration, “Joint Declaration of the European Ministers of Education”, which was first signed by 29 countries and has now been signed by 49 under European Cultural Convention by the Council of Europe, affected the planning education systems in European countries to raise diversity and internationality in education by promoting

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exchange among students and teachers in various degree programs setting mainly 6 objectives (Bologna Declaration, 1999). The objects can be summarized as below:

(1) Adoption of a system of easily readable and comparable degrees to promote European citizens employability and competitiveness of European higher education;

(2) Adoption of a system essentially based on undergraduate and graduate education system, which aims qualify the degree system to make relevant labor market in Europe;

(3) Establishment of a system of credits to promote the widespread student mobility including lifelong learning;

(4) Promotion of mobility to make accessibility to study and training opportunities and related services for students and teachers;

(5) Promotion of European co-operation in quality assurance with a view to developing comparable criteria and methodologies;

(6) Promotion of the necessary European dimensions in higher education.

Bologna Declaration itself is not including the contents to reform the planning education in Europe, however Frank et al. (2014) pointed out the impact of this declaration such as: to assist increasing awareness of existing diversities (page 75 in the Frank’s work) or emergent “Europeanisation” of planning education program (page 78); to promote the higher degree of planning in professional associations and promote the diversification of planning course students’ academic background (page 75); and to provide the European-wide planning topics and foster the education program which provide the experience to participate, learn and research in the European-wide planning situation (page 80).

Based on the declaration, European countries’ governments and international, domestic educational institutes created frameworks for planning education. The Association of European Schools of Planning (AESOP)’s program is based on three main themes: “acquire due knowledge,” “develop practical competence,” and “develop an attitude.” Furthermore, they developed 21 detailed goals relating to these three themes (AESOP website: Geppert et al., 2008). For example, future prediction, which is the focus of this paper, is described as one of the goals “Develop practical competence in anticipating future needs of society, including the appreciation of new trends and emerging issues in planning”. In addition, England’s National Centre for Entrepreneurship in Education (NCEE) has education programs for entrepreneurial planning based on three main categories, including (1) values, attitudes, and approaches; (2) generic competencies; and (3) business-related competencies, with seven categories and 48 detailed educational goals as their entrepreneurship education program’s elements (NCGE, 2006: Frank, 2007). Frank pointed out not only the difference between planning education in benefit-oriented goals or quality of life (QoL)-oriented goals, but also the common points in the importance of vision forming, problem definition, mutual understanding, and stakeholder analysis.

On the other hand, what can be done about planning education in Japan? Some reports have been made on outcome analyses of planning education. Kosugi et al. (2003) analyzed the educational practice of “community design” in Chiba and the relationship between the program design and the students’ learning outcomes. This study analyzed the development process of students’ suggestions for community groups based on the answers provided on worksheets. Fukui et al. (2002) investigated the educational program “Urban education in community for children” in Japanese junior high schools. In this study, the importance of designing a planning education program through collaboration not only among school staff but also experts, community groups, and municipalities through the interview survey conducted with the school managers, teaching directors, and teachers.

In addition, research has been conducted on curriculum design in planning education. Maeda et al. (2017) reported on the practice of project-based learning in an architecture and urban design school. According to their findings, the school, which has bachelor’s and master’s degree students, set five
main goals, which are 1) architectural design education from the local traditional buildings, 2) research of urban attractiveness and problem, 3) discussion and learning through the open workshop, 4) international workshop program based on the partnership with the universities oversea, and 5) information disclosure through the discussion paper, and created detailed course plans to implement the planned learning opportunities centered on project-based learning to satisfy those five goals, which are collaboration-oriented with local/international society.

From these previous studies in the Japanese context, two common characteristics can be identified in Japanese planning education research:

1. The trend of project-based learning;
2. Educational practices based on “current/near future” problems.

On the other hand, as Frank (Frank, 2007, Frank et al., 2014) described, not only generic and specific competences can be learned from project-based learning, but also values, attitudes, and approaches as planners that are based on the learners’ philosophy, interests, and understanding of society.

Of course, this paper does not intend to deny the meaning of PBL in planning education, but this paper focused on “future prediction” education as one of the elements of planning education to foster learners’ philosophy. AESOP pointed out the importance of “anticipating future needs of society, including the appreciation of new trends and emerging issues in planning” (Geppert et al., 2008) as a practical competence of planners. Furthermore, the organization emphasized that planning attitudes “be basically oriented towards solving the needs of society within the framework of sustainable development” (Geppert et al., 2008).

Some studies have reported on future prediction in career-planning education (e.g., Yamazaki et al., 2015), but there are currently no studies on future prediction practice in public planning education. Concerning the impact assessment of climate change, population decline, and social implementation of AI/IoT in the future (e.g., Central Environment Council, 2015; METI, 2017; Davenport, 2015), research should focus on devising appropriate educational methods to improve to students’ vision and foresight based not only on analyses of current situations but on future prediction.

The present study, as a fundamental work on future prediction in planning education, aims to develop an instructional method to be used in a first-year university planning education program, based on the results of surveys, interviews, and data mining from student worksheets. The research was conducted at Ritsumeikan University, Japan.

1. METHODS
1.1 Theoretical framework of future prediction
Future prediction can also be expressed as qualitative or quantitative future simulation. Simon (1996) expressed the importance of the critical analysis of multiple possible future scenarios in planning reviewing the Rome Club’s work (Meadows et al., 1972). Based on a planning theory perspective, Allmendinger (2009) pointed out that planning should be considered a dynamic and self-changing system. These researchers implied that future prediction consists of: (a) detection of critical factors for social, economic, and environmental conditions in the future; (b) identification of causal and trade-off relationships among critical factors and future conditions; and (c) impact assessment and scenario-building to solve problems by leveraging their strength and overcoming their weakness (see also Harashina, 2000).

1.2 Instructional design for future prediction education
The present study was conducted in two lectures of the course “Introduction to Research Projects” (Japanese course) in the college of policy science at Ritsumeikan University. This course aims to foster the development of students’ policy analysis skills in a small class environment: therefore, this was achieved by separating all students into 13 classes. (As explained in the latter part, the author of the present study conducted the lectures in 3 classes of them.) Each class consists of 15 lectures in an autumn semester, and six lectures are dedicated to an introduction to policy analysis by three lecturers.
with different specialties (two lectures on three themes: political science, socio-economic studies, and environmental studies). In those six lectures, each lecturer conducted the same two lessons about their specialty in three classes. The author of the present study conducted future prediction lectures in those three classes, as shown in Table 1.

Based on the three key elements described in Section 1.1, the class framework for future prediction education was developed (Figure 1). Considering the time limitation and asymmetry of knowledge and thinking skills among the students, the class framework was constructed as below (see also Figure 1 and Table 2).

**Figure 1. Class framework of two lectures.**

**Table 1. Summary of Lecture Outlines.**

<table>
<thead>
<tr>
<th>Class</th>
<th>X</th>
<th>Y</th>
<th>Z</th>
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<tr>
<td>1st Lecture</td>
<td>2017/10/16 n = 25</td>
<td>2017/10/30 n = 28</td>
<td>2017/11/13 n = 26</td>
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</table>

* \( n \) refers to the number of students who attended the lessons.

**Table 2. Summary of Mini-Lecture Contents.**

<table>
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<tr>
<th>Theme</th>
<th>Contents</th>
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<tr>
<td>Population Change</td>
<td>• The global population will continue to increase while Japan’s population will decrease.</td>
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<td>• Some small communities in Japan may disappear in the future.</td>
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<td>• Food importation will become more difficult because of population growth in Asia and Africa.</td>
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<tr>
<td></td>
<td>• The global climate will become more extreme, which will affect human health and food production.</td>
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<tr>
<td>Climate Change</td>
<td>• Animal/plant distribution will also change because of global warming.</td>
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<td>• This may create business opportunities for the leisure industry and consulting companies.</td>
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<tr>
<td>Food</td>
<td>• Population growth and urbanization in developing countries will cause an increase in global food demand.</td>
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<td>• Effective land use and food production will be key issues in Japan.</td>
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<td>• “Vegetable factories” and technology-based smart agricultural management is being developed.</td>
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<tr>
<td>Technology</td>
<td>• It is expected that social implementation of autonomous cars will promote the effective use of energy and fast and smooth traffic.</td>
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<td>• AI/IoT implementation in business situations will make task flow and supply chains more effective, reducing the need for human employment.</td>
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<td>• It can be an opportunity to fundamentally reform the human lifestyle.</td>
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**[Homework]** "Anticipating my life in 2040"

To simplify the task, the students were asked to think about what their life would be like in the year 2040. To facilitate their descriptions of the future, the boxes labelled “Job,” “Private,” “Family,” and “Environment” were placed on the worksheet distributed to the students.

**[Briefing]** "Explanation of meaning and purpose"

To promote the students’ understanding of the work, the meaning and process of the lectures was explained at the beginning of the lesson 1 to each class. The author emphasized that the students should pay attention to the information about promotional factors (opportunities) and obstructive factors (threats) in the mini-lecture held in the next.

**[Mini-Lecture]** "8 min. lecture on future events"

Based on the existing literature, a mini-lecture on future events was conducted. In the lecture, future events such as population change, climate change, food, and technology were discussed, and only
Students extracted or considered promotive factor (opportunities) and obstructive factor (threats).

<table>
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<tr>
<th>Opportunities</th>
<th>In 2040, I’ll be…</th>
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<tr>
<td>Job</td>
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<td>Private</td>
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<td>Family</td>
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<td>Environment</td>
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**Figure 2. Worksheet on future scenarios.**

Students expressed their own scenario using one-side arrows (causal relationship), double-side arrows (trade-off relationship), and memos.

Qualitative descriptions were used in the presentation slides (Table 2).

**[Group Discussion1] “What is critical or assistive?”**

After making their predictions on the worksheet, group discussion was held to share and think about the critical and assistive factors to achieving each student’s future predictions. This stage corresponds to the element (a) in section 1.1.

**[Homework2] “Future scenario-making”**

In the second lesson, the students prepared future scenarios based on their work in the first lesson. For this assignment, it was emphasized that the students should make scenarios not only based on the factors themselves but also on the causal and trade-off relationships between the 2+ factors. This stage corresponds to the element (b) in section 1.1.

**[Group Discussion 2] “How about my scenario?”**

At the beginning of the second lesson, scenario-sharing discussion among the groups was held. The author encouraged the students to think about what they should do to achieve preferable future conditions.

**[Debriefing] “Future prediction for planning”**

After submitting the worksheet, the author asked the students to review their understanding of future anticipation prior to the first lesson to gather the students’ opinions.

**1.3 Evaluation of students’ achievement and understanding**

To discuss the educational methodology for future prediction, the steps of investigation outlined in the following sections were followed.

In the model lectures, the students described their own future scenarios on the worksheets expressed in Figure 2. To analyze the worksheet as the output of the students’ learning, network analysis among “future events” predicted by the students themselves (see also 1.3.1).

On the other hand, the output of lectures should be affected not only by the contents of lectures but also by the recognition to the lectures and the future prediction itself. Therefore, as the second step of the survey, the cognitive analysis is conducted in the latter part. Network analysis explained in the previous paragraph was conducted including the recognition to the lectures to describe the relationship between the worksheet contents and recognition (see also 1.3.2).

**1.3.1 Achievement evaluation from the work**

The first step was the evaluation of students’ achievement through the work. To discuss the validity and limitation of the class design explained in section 1.2, a trend analysis of the worksheets as the students’ output was conducted. An image of the worksheet distributed in the lectures is displayed in Figure 2, and the scenario was expressed in the causal relationship and trade-off network among the future events and the anticipated future conditions explained by the students on their worksheets.

To evaluate the trends in the students’ outcomes, a network analysis was conducted in the second part of Chapter 2. Network analysis is derived from graph theory and it has been applied not only to information technology (Rappaport, 1979: Rogers et al., 1981) but also to social analysis (Bott, 1957). Through network analysis, the tendencies in students’ future scenarios can be analyzed not only quantitatively by graphing networks among the future events and future conditions, but also qualitatively by using network indicators to summarize the characteristics of the network, nodes, and links. In this paper, the nodes...
characteristics are discussed by using centrality indicators. Centrality indicators summarize the importance of each node in the network, and several kinds of centrality indicators have been applied in the existing literature. The correct indicators for analyzing network characteristics are discussed in Chapter 2.

1.3.2 Analysis of the recognition survey

The second analysis was based on the students’ recognition of planning itself, future predictions, and the lectures. As Ajzen (1991) depicted, the critical factors for predicting human activity can be classified into “attitudes,” “subjective norms,” “perceived behavioral control,” “intentions,” and “behavior” (known as the theory of planned behavior). The theory of planned behavior has been applied to not only eco-activity and voluntary activity research but also to education research as a cognitive description tool (De Leeuw et al., 2015; Chu et al., 2016; Ono, 2018). According to this model, whether the students consider future predictions and future scenarios based on deliberation depends on (1) recognition of necessity to think about the future, (2) recognition of ability to think about the future, and (3) recognition of social norm pressure to think about the future. Then, the item (1) derives from “attitude” in TPB model but it is not necessarily equal to recognition (1). Besides, (3) is also from “subjective norm” but not necessarily equal it. The reason why setting these three survey items apart from TPB model is because the lectures areintroductive for the 1st-year students and the author aimed to raise the necessity recognition as the basis of attitude change. To assess the students’ perceptions of these factors, the first survey was conducted at the beginning of the first lesson with each class.

The author conducted the second survey at the end of the second lesson with each class. The students would be stimulated by the contents or experiences in the author’s explanation or group discussion depicted in Figure 1. To assess student understanding, the question to ask the first-, second-, and third-most impressive contents in the lecture by preparing the choices. In addition, the cognitive questions based on the theory of planned behavior were added to the survey sheet to compare student understanding of the learning objectives before and after the lectures. The question list of the survey is displayed in Table 3.

1.4 Analysis framework and the limitations of the present study

The analysis framework is described in Figure 3. First, by summarizing the questionnaire survey, the recognition of planning, future prediction, and lecture itself is described section 2.1. Next, based on the students’ worksheets, a network analysis was conducted to display the tendency of their future scenario reflecting the result of cognitive analysis in 2.1 (2.2). After that, discussion about the three topics is presented in Chapter 3 to extract the implications for developing an effective instructional method for planning education.

As explained at the end of the Introduction and in Table 1, the present study was conducted in a university and the sample size is small. For these reasons, the findings of the present study will not be able to be generalized immediately. However, the present study has the characteristics of (a) conducting a network analysis to graph and grasp the tendency of students’ considerations, (b) applying an experimental approach to compare the conditions before and after lectures, and (c) conducting an educational process based on future predictions as an important element of planning education research.

2. RESULTS

2.1 Cognitive analysis of the surveys

2.1.1 Summary and cognitive change

Table 4 provides a summary of the survey completed by the students. This survey was conducted in three classes (X, Y, and Z), and the total number of respondents was 79 for the first survey (before the lessons) and 77 for the second survey (after the lessons).

The distribution of students’ sub-major, which are registered based on their own interests, was environmental studies for 22 students, socio-economic studies for 38 students, and political science for 39 students. It can be said that the number of students interested in environmental studies was less than the other students.
Table 4 displays the respondents’ recognition of the four policy issues (energy use, food production and consumption, amenities, climate change) in the two surveys and a statistically significant difference between the first and second survey was found for food policy recognition in all classes (according to a t-test, \( p < .05 \)). In these two surveys, the author asked a question about the necessity of future prediction, and statistically significant difference about the necessity between the first and the second survey was also found in the all respondents according to a t-test (\( p < .05 \)). Significant difference among three classes in each question was not found according to ANOVA (\( p > .05 \)).

2.1.2 Impressive contents in the lecture

Table 5 displays the results of the cognitive survey about impressive contents in the lectures. All respondents chose the first-, second-, and third-most impressive contents in the classes as depicted in Figure 1, and 10+ respondents answered “briefing,” “mini-lecture,” “group discussion 2”, and “debriefing” as the most impressive contents. From the total number of answers, the students answered “mini-lecture” most often.

To assess the tendencies in the students’ understanding, Table 6 displays a frequency table classifying all contents into two categories (Work/Lecture). This categorization has also been expressed in Figure 1. According to Table 6, 47 respondents answered 2 + “Lecture” classified contents, and 70.2% of those (33 respondents) were affected by “mini-lecture” as the first-, second-, or
Table 7. Adjacent Matrix of the Relationships among Future Events.

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<td>Th:Tec-Fam</td>
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<td>Th:Tec-Env</td>
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</tbody>
</table>

Note: Op: Opportunity, Th: Threat, Pop: Population Change, Chi: Climate Change, Fod: Food, Tec: Technology, Job: Job, Pri: Private, Fam: Family, Env: Environment, from technology for family’s happiness, 0(min) 31(Max)

Table 8. Ranking Category and Centrality Index.

<table>
<thead>
<tr>
<th>Ranking (1st)- (2nd)- (3rd)</th>
<th>B. C.</th>
<th>Freq.</th>
<th>B. C./Freq.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Work - Work - Work</td>
<td>28,066</td>
<td>5</td>
<td>5,613</td>
</tr>
<tr>
<td>Work - Work - Lecture</td>
<td>19,416</td>
<td>8</td>
<td>2,427</td>
</tr>
<tr>
<td>Work - Lecture - Work</td>
<td>46,093</td>
<td>9</td>
<td>5,121</td>
</tr>
<tr>
<td>Lecture - Work - Work</td>
<td>14,492</td>
<td>8</td>
<td>1,812</td>
</tr>
<tr>
<td>Work - Lecture - Lecture</td>
<td>4,710</td>
<td>6</td>
<td>0,785</td>
</tr>
<tr>
<td>Lecture - Work - Lecture</td>
<td>92,269</td>
<td>14</td>
<td>6,591</td>
</tr>
<tr>
<td>Lecture - Lecture - Work</td>
<td>101,718</td>
<td>9</td>
<td>11,302</td>
</tr>
<tr>
<td>Lecture - Lecture - Lecture</td>
<td>300,236</td>
<td>18</td>
<td>16,680</td>
</tr>
</tbody>
</table>

* B.C.: Betweenness Centrality

third-most impressive contents. As expressed in Table 5, the students changed their awareness of the social need for future prediction through the lecture, especially concerning food production. The impact of the mini-lecture on the students’ awareness can be inferred by from these interpretations.

2.2 Network analysis of worksheets

2.2.1 Position of future events in worksheets

As explained in section 1.3.1 and Figure 2, each student expressed future opportunities and threats in their worksheet and they listed two or more of each. As the first step of the worksheet analysis, the tendency of students’ recognitions of future opportunities and threats were identified. Table 7 displays the frequency of the relationships among future events (opportunities / threats) that were identified in the network analysis. For example, if the future opportunity about jobs caused by population change (Op: Pop-Job) and the future threat about private life caused by climate change (Th: Cli-Pri) were simultaneously observed on one student's worksheet, one frequency was added to the grid, which is in the cross of the row named “Op: Pop-Job” and the column named “Th: Cli-Pri.” To make it more visual, the frequency in each grid has been expressed in colors (white/grey/black), not in numbers.

As shown in Table 7, many students expressed population change and technological innovation as both positive and negative future events in their worksheet. Furthermore, many students regarded climate change as a negative factor in the future. As explained in 2.1.1 and Table 4, the recognition of the need for future predictions increased at a statistically significant rate in all classes, and many students identified the “mini-lecture” as the most impressive contents of the lessons. Based on these results, the contents of the mini-lecture significantly affected the students’ future predictions.

2.2.2 Relationship between the recognition of impressive contents and future events

Next, to discuss planning education strategies, the relationship between the recognition of impressive contents and the trends of student worksheets was analyzed by applying the network analysis framework. As explained in section 1.3, each student answered the questions about the impressive contents on the second survey (see also Table 6), and he/she also submitted the worksheet, in which future events (opportunities/threats) were predicted. In this part, the network analysis of the impressive contents recognition and future events was conducted using the following 3 steps:

1. making cross tabulations between the impressive contents (such as “Work-Work-Lecture” in Table 6) and future events (such as “Op:Pop-Job” in Table 7), then frequency means the number of worksheets;
2. describing the network graph, in which the
nodes correspond with impressive contents and future events, and the edges correspond with the frequency between any two nodes that are greater than or equal to 1; and (3) calculating the centrality index of each node of the impressive contents, which indicates the diversity of edge from/to each node.

In the present study, Freeman’s betweenness centrality (B.C.) was applied to measure the nodes’ characteristics (Freeman, 1979). The central means of B.C. is clarifying the importance of a node to bridge between the other two nodes, and B.C. itself can summarize the degree of connection with the other nodes (Suzuki, 2017). In addition, in this research framework, the values of B.C. depend on the frequency that indicates the number of the students classified in each ranking category. Based on this understanding, comparison analysis, not only about B.C., but also about the value of B.C. divided by frequency, was conducted, as shown in Table 8. According to Table 8, the B.C. value and the B.C./Freq. of the ranking category “L-L-L” was the highest of all the categories. In addition, “L-L-W” and “L-W-L” were the second and third largest values. From these results, the students affected by the lecture contents would consider their own future scenario from diverse perspectives.

Next, Figure 4 shows the network graph of the impressive contents and future events in the worksheets. As displayed in Table 8, the nodes that include “lecture” as the impressive contents (such as “L-L-L”, “L-L-W”) had a greater number of edges to future event nodes than the nodes including “work.” On the other hand, the nodes including “work” tend to have characteristic nodes. For example, the nodes “Th:Pop-Pri,” “Op:Fod-Job,” and “Op:Pop-Job” had no edges with “L-L-L”; but they did with “W-W-W,” “W-W-L,” and the other nodes including “work.”

3. DISCUSSION

3.1 Students’ recognition of the necessity of future prediction

As shown in Table 4, the students’ recognition of the necessity of future prediction was promoted through the lectures in all three classes. There were statistically significant differences between the first and second surveys ($p < .05$), and it can be said that there are the important factors to promote future prediction among the students. As displayed in Table 5, most students were affected by the “mini-lecture,” “group discussion 2,” and “debriefing,” and some students who answered the additional interview survey explained their recognition and reaction as follows:

On the mini-lecture and debriefing:

- “I understood the result of the impact assessment of climate change in detail and felt uneasy about whether I can adapt to it well in the future.” (1-1)
- “I have no idea whether IoT or any other technical innovation will improve our quality of life.” (1-2)

On group discussion 2:

- “Other students’ stories were helpful for my scenario completion. I could hear other ideas about the same topic multi-directionally.” (1-3)

According to student (1-3), group discussion about the worksheet assisted some students in improving their understanding of future events, predictions, and their future scenario on the worksheet. On the other hand, as expressed in Tables 5 and 6, many students were affected by the “lecture type contents” of the lesson series, not the “work type contents.”

There should thus be certain conditions to foster student awareness of future predictions. This will be discussed further in section 3.3.

In addition, some students seemed to be extremely affected by the negative information in the mini-lecture and debriefing, as expressed in the interviews by students (1-1) and (1-2). As described in Table 7, the students mentioned negative information about future events (threats) on the worksheets more than positive information (opportunities). Especially, the information about climate change was regarded as a threat in their future scenario. An appropriate lecture strategy should thus be discussed to avoid extremely negative recognition and future predictions (see section 3.2).

3.2 Trends in the students’ future scenarios

As explained in Table 2, the contents of the mini-lecture included the anticipated positive/negative
impact on the future life, especially concerning food and employment. As shown in Table 7, the students tended to express the negative impact on employment and food in the future, while they also regarded technical innovations and population change as opportunities in their future scenarios.

About this focus point, the interview results about homework 2 is interesting:

**On homework 2:**
- "I felt uncomfortable with the classroom work, and I referred to the newspapers and reports about the negative events in the future." (2-1)
- "In the classroom discussion (*Group discussion 2), my group members had different kinds of ideas. I couldn’t decide which was correct so I read some articles, especially about IoT." (2-2)

These opinions were both based on the document survey in the homework. However, (2-1) was based on the survey about the negative events, which assisted the students' negative perceptions of future events, while (2-2) was based on both positive and
negative information. This implies the need for “assistant tools” for multilateral consideration of future events and scenarios.

3.3 Strategy for future scenario-based planning education

As explained in 3.1, there was a kind of uneasiness for the future vision deriving from the mini-lecture. To avoid growing negative recognition for the future extreme, the author held “Group Discussion 1” after the mini-lecture, but those facts indicated that the goal of the group work was not completed. About “Group Discussion 1,” some students expressed contrasting views during the interviews.

About Group Discussion 1:

- “The group members’ ideas might be correct, so I adopted them partly.” (3-1)
- “One of the members had a unique idea and we used the discussion time to consider the correctness of it. I used it partially in my work, but some members didn’t.” (3-2)

The explanation of students (3-1) and (3-2) contrast with respect to the idea of critical thinking. The group in which future events were discussed in the way of student (3-2) can be regarded as a deeply thinking and discussing group. The respondents who held views like student (3-2) tended to have answered that they were “impressed by the lectures” and reflected on the future events explained at the end of section 2.2.2 in their worksheets. Based on the results of the surveys and interviews, discussion in critical thinking affected the deepness of the students’ understanding and their considerations while making future predictions.

CONCLUSIONS

The present study attempted to extract lessons for planning education applying a scenario-based instructional approach. Making and implementing environmental policies or environmental plans (especially based on SDGs) requires the skills not only to analyze concise environmental, economic, social benefits and impacts but also to formulate science-based scenarios based on future predictions and scientific research. Then, qualitative future scenario-making should be a meaningful method in introductory lessons on policy-making and planning.

Based on this perspective, the author conducted surveys, interviews, and a worksheet analysis through a model lecture about future prediction in a university. As discussed in 2.1.1, the significant difference between before and after the lectures was found about necessity recognition of future prediction (from 2.85 to 3.16 in arithmetic mean). In addition, this is limited in the topic about food policy, there is also significant difference about future prediction of food production/consumption (from 4.00 to 4.52). These results imply the effect of the implementation of future prediction in this introductory course.

Through the network analysis research in 2.2.2 and the discussion 3.1~3.3, lessons on the application of scenario-making in planning education are outlined below:

(1) It is inevitable that some students will feel uncomfortable in future scenario-making because of the negative aspect and unpredictability of future events. It is important for instructors to help students consider policy-planning options that can help us to mitigate or adapt to such events (such as climate change policy).

(2) Homework is an important process in promoting multilateral consideration based on existing research and documents, but it also causes the polarization of ideas, especially regarding negative understanding. To avoid this, using a worksheet or checklist is essential in promoting student self-monitoring of homework and consideration of future events and scenarios.

(3) On the basis of (1) and (2), the encouragement of critical thinking is one of the most important goals in designing educational material in scenario-based planning education. For example, to promote imagining and writing down the counter opinions of other students and engaging in deep discussion based on them can be considered an optimal method of promoting critical thinking.

Future research should be dedicated to developing the educational material reflecting the
outcomes of the present study, and to observing the behavioral causal relationships through interviews and surveys.

ACKNOWLEDGEMENTS

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REFERENCES


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