1. Introduction

Nations around the world have tried to educate citizens to improve a wide range of food and dietary habits in order to address complex agri-food system problems brought on by industrialization and globalization. Since 2005, Japan has promoted a food education initiative called Shokuiku, but has been unable to claim any significant success in producing more food-aware citizens.

Perhaps more worrying researchers has been largely unable to critically assess the success of their initiative through a system of impact evaluation, which has slowed efforts to refine and develop the program. This admission was made indirectly by the scientific society when it announced a re-emphasis on “evidence-based” food education [1]. This means that food education programs should be developed on a basis of scientific evidence, such as evaluated educational impacts, instead of heavily relying on impromptu ideas and thoughts brought by teachers on site who are not generally experts in food education.
L’éducation sensorielle (sensory education or taste education) is one successful education model which has been developed and refined based on theories and principles in sensory study and behavioral science. Sensory education, which was first developed in France in 1970s, aims to develop food curiosity, refine sensory systems and enhance food literacy. Currently, two different models of sensory education have been promoted in France: (1) Classes du Goût (Classes of Taste) and (2) its short-versioned model called, Leçon du Goût (Lesson of Taste) (Table 1).

This learning method consists of three different phases: a question phase helps children explore the theme of the day; a tasting phase provides foods and their relevant information and enables the children to reach a practical level of understanding about how the gustatory system works; finally, the children's various responses are brought together with complementary input on the initial question posed at the beginning of the class. This module comprises 10-12 sessions on food-specific topics as described in Table 1, and these lessons are integrated into the national education program under the title, Classes du Goût [2].

This pedagogy is particularly rich in opportunities for sensory experience and pays attention to each child's individual differences, whereas comparable food education schemes (home-economics, nutrition education, etc.) tend to involve rote information dissemination and a dualistic approach that differentiates artificially between good and bad dietary behavior. In response to the gradual realization that the latter type of traditional educational models, in general, have been unable to improve a wide range of children's dietary behaviors, this type of sensory-based educational model that also accentuates the pleasure of eating has been recently employed by a growing number of food education organizations.

To assess the benefits of sensory education, several national research projects have been conducted in France and other European countries. EduSens, a French research project conducted in 2005 by INRA (National Institute of Agricultural Research), showed that Classes du Goût decreased food neophobia, improving taste expression ability, and positively changing taste preference [3], while a study conducted in Finland revealed improvements in the sensory ability to identify tastes and odors [4]. Although behavioral impacts of Classes du Goût have not been examined yet, significant impacts on cognitive and attitudinal aspects of children's dietary habits have been observed. Due to its potential as an effective food education model, sensory education has been included in French health and agricultural policies in the form of school curricula and/or national events [5].

Likewise, the demand for better food education pedagogy is growing in Japan, and it is thus not surprising that sensory education has been viewed as a potential model. Its evidence-based approach, which had been lacking in Japan, has distinguished itself from pre-existing

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**Table 1 Two Different Programs of Sensory Education**

| Country                     | ‘Classe du Goût’                                      | ‘Leçon du Goût’                                      |
|-----------------------------|-------------------------------------------------------|------------------------------------------------------|
| Occasion                    | School curriculum                                     | Annual event ‘La Semaine du Goût’                    |
| Lesson                      | 10-12 Lessons                                         | 2 Lessons                                            |
| Content                     | 'The five senses,” “Taste,” “Vision,” “Olfaction,” “Touch and hearing,” “Aroma,” “Flavor,” “Preparing a dish,” “Food preferences,” “Regional specialties,” “Recapitulation,” “The festive meal,” etc. | “The five senses,” and "Tasting application" |
| Educational Impacts         | Cognitive and attitudinal aspects of dietary habits   | Not examined                                         |

Source: Developed by the author using Reverdy et al. (2011) and Kubota et al. (2011) [2, 10].
food education models such sufficiently that an active grass-root movement has developed to support it.

Although several studies published in Japan have analyzed how sensory education has been promoted in France in order to elucidate how Japanese food education can be improved, only a few studies have conducted impact evaluation of the existing sensory education programs in Japan. In one of these, Tokumaru et al. (2014) showed that sensory education-based home-economics classes, which consisted of 19 classes based on some of the program contents of Classes du Goût, facilitated children’s understanding of taste mechanism and improved their taste description ability [6]. In another study, Hayabuchi (2015) reported that two classes of sensory education could improve children's sensory abilities [7]. However, impact evaluation studies of sensory education in Japan are still lacking in spite of the growing trend in which more and more teachers try to learn and incorporate its pedagogy into elementary school curricula.

On the other hand, in France, La Semaine du Goût has been developed since 1990 with the support from Ministries, public and private organizations, and in which over 6,000 Leçon du Goût were performed in 2007 [8]. Being derived from the French national initiative, chefs and food producers in Japan have started being mobilized under a recent initiative called, La Semaine du Goût au Japon (The Week of Taste in Japan) (see Table 1). More than 370 lessons of Leçon du Goût, a short-version (two classes) of Classes du Goût, where chefs and food producers provide sensory education classes in schools, were performed in 2015 [9]. Considering this growing attention from various stakeholders in the agri-food domains, it is important to assess the educational impacts of Leçon du Goût, the most dominant sensory education program in Japan, in order to further refine and promote sensory education in Japan.

As shown above, we will conduct an impact evaluation on Leçon du Goût, a prominent educational model in Japan. To achieve this goal effectively, this study aims to (1) develop an impact evaluation system adapted for Leçon du Goût (hereafter, “program”): (2) analyze the actual practices in Japan; and (3) assess the educational impacts on children’s dietary habits.

2. Development of Impact Evaluation System

To develop an impact evaluation system adapted for Leçon du Goût, the following documents were analyzed to identify the educational impacts that promoters expect to achieve through this program. The first analysis was made of the Teaching Guideline of Leçon du Goût [10] and relevant official document issued by the host organization of this initiative [11], which taste educators are generally required to follow. Second, assuming that there might be other educational impacts and their evaluation methods that the Guideline does not cover, a literature review was conducted on the studies of sensory education, mostly on Classes du Goût, to seek these out. Third, all the impacts expected from these, as well as the Guideline and the official document, were consolidated with a view to determining their utility for evaluation methodology. Lastly, each educational impact and its evaluation method were scrutinized to propose the impact evaluation system for the following study.

1) Teaching Guideline of Leçon du Goût

Basically, educators (chefs, food producers, etc.) should conduct sensory education classes under the framework and principle stipulated in the Guideline [10]. However, we alternatively
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referred to the relevant official document to extract its intended educational impacts, since the Guideline does not definitively mention educational impacts and their evaluation methods [11]. Although a reasonable level of modification and arrangement is allowed for experienced educators, new educators who take a half-day training course before giving classes, as well as experienced ones, generally embrace the following premise [11]:

"Children can learn five senses and five tastes and experience pleasure and depth of tasting through Leçon du Goût. They can also differentiate taste differences and characteristics of foods and improve their description ability by expressing the tastes they feel with their own words. Leçon du Goût is an opportunity for them to encounter ‘taste’ and enhance their curiosity toward ‘food’ as a part of the culture of the pleasure of tasting (translated from Japanese to English by the author)."

This premise indicates that the following five educational impacts are highly expected to gain through this program: understanding of taste mechanism (basic five senses and five tastes); pleasure of food and tasting; food differentiation; taste expression; and curiosity toward food.

2) Literature Review of Sensory Education Studies

To identify other expected educational impacts, studies on sensory education programs published in English, French and Japanese until October in 2015 were reviewed. These literatures are summarized in Table 2, showing the following six expected educational impacts: understanding of taste mechanism, food differentiation, taste expression, taste preference, and food neophobia, and curiosity toward food.

3) Consideration for Methodological Feasibility

After the analysis on the Guidelines and the following literature review, the seven educational impacts were determined (Table 2). However, there is no reliable evaluation method nor has there even been an attempt to evaluate pleasure of food and tasting in the past researches. Considering this methodological limitation, the following six educational impacts, excluding pleasure of food and tasting, were finally identified as evaluation indicators for Leçon du Goût.

4) Evaluation Method of Educational Impacts

We will hereafter assess the utility for evaluation methods for the educational impacts which were identified in the preceding section and then propose their impact evaluation system by taking into an account the past researches and our perspectives.

Table 2 Summary of Literature Review of Educational Impacts of Sensory Education and Final Indicators

| Educational Impacts | (1) Guideline | (2) Literature Review | (3) Final Indicators |
|---------------------|---------------|-----------------------|---------------------|
| Understanding of taste mechanism | ○ | Improvement (Tokumaru, 2014) [6] | ○ |
| Pleasure of tasting | ○ | − | ○ |
| Food differentiation | ○ | Improvement (Mustonen 2009) [4]; (Hayabuchi, 2015) [7] | ○ |
| Taste expression | ○ | Improvement (Mustonen 2009) [4]; (Reverdy, 2010) [19]; (Tokumaru, 2014) [6] | ○ |
| Taste preference | − | Increased preference for complex flavors (Reverdy, 2004) [18] | ○ |
| Food neophobia | − | Temporal decrease (Reverdy, 2008) [14]; Decrease (Park, 2015) [20] | ○ |
| Curiosity toward food | ○ | No significant increase in this study (Gaignaire, 2011) [13] | ○ |

Source: Developed by the author using the literature in the table.
Note: The circle indicates that the educational impact is “expected” while the bar indicates “not expected.”
part of 'taste.' Rather, a sense of 'taste' is created through the interaction of the five senses (taste, vision, hearing, smell, and texture) and even emotions as well as cultural and physiological conditions [12]. Thus, a basic understanding about this complicated taste mechanism is essential to effectively conduct tasting practice and acquire other educational impacts. In order to measure this, Tokumaru’s method was employed [6], in which children were asked open-ended questions about the five senses and five basic tastes, as indicators for measuring the level of understanding of taste mechanism, and the number of correct answers about each taste and sense was compared before and after the program.

(2) Food Differentiation
Mustonen et al. (2009) proved that 10 lessons of Classes du Goût improved the skills of children aged 7-11 to identify tastes and odors and to characterize foods by conducting sensory evaluation in the laboratory settings, such as free odor naming, taste identification of six solutions, and rating attention paid to the sensory properties of foods [4]. However, Mustonen’s method is ultimately not suitable for this research, given that this study intends to develop a feasible and practical evaluation system under normal school settings. Instead, this study applied Hayabuchi’s dietary record-based model in which the children were asked to identify the names of foods and seasonings used in the school meals [7]. To minimize the effect resulting from the variety of school meals, the average score was calculated from the correct identified foods for three consecutive days and used for comparison before/after the program. The foods and seasonings served in the school meals are listed in Appendix 3.

(3) Taste Expression
Gaignaire’s method was applied to evaluate children’s taste expression ability [13]. Using this method, the children were asked to describe the tastes and sensory impressions of school meals on the dietary recording sheets for six days around the program. Their description texts were then analyzed and compared with a special focus on the five basic tastes and other taste-related nouns, adjectives, adverbs, na-adjectives (keiyo-doshi), the types and frequency of these words before/after the program.

(4) Taste Preference
In the principles of sensory education, it is expected that taste preference for more complexity and less intensity will enable children to lessen their excessive desire for sugar and fat and also discover more variety of flavors and foods [3]. Thus, children’s declarative preference for taste complexity and intensity was used as indicators for assessing how the program manages to shift their taste preference. The children were asked to indicate the degree of complexity and intensity to which they considered the most favorable for them, ranging from the lowest “very simple (weak) (1 point),” “simple (weak) (2 points),” “complex (intense) (3 points),” to the highest “very complex (intense) (4 points).” In addition, open-ended questions about their associations with pleasant and unpleasant tastes were conducted to holistically comprehend their taste predilections.

(5) Food Neophobia
Food neophobia can be seen as a personality characteristic and measured with a questionnaire such as Reverdy’s adapted food neophobia scale (AFNS) [14], or more generally as behavior involving the rejection of a novel food, which is evaluated in terms of the average
willingness to taste novel foods in relation to the willingness to taste familiar foods [15]. Given the environmental constraints in the normal school setting, this study only employed the AFNS to measure declarative food neophobia. This test questions were translated into Japanese (the AFNS consisting of 10 items is described in Appendix 1). For questions 2, 4, 5, 6 and 8, the scale ranged from “very true for me” response (7 points), “true for me” (5 points), “not true for me” (3 points), and to “not at all for me” (1 point). For questions 1, 3, 7, 9, and 10, the scores were reversed.

6) Curiosity toward Food
There has been no clear definition of “curiosity toward food” and its evaluation method. Gaignaire’s research group was perhaps the first to define it as “the ability of the eater to want to know everything that is related to food, whether at the stage of production, processing and consumption” and to develop a measuring scheme based on this definition. From the experience gained from the EduSens project, eight attributes were ultimately identified that were most highly likely to be gained through Classes du Goût, with the resulting scores signifying the degree of curiosity toward food in children’s dietary attitude and behavior, ranging from production, and preparation, to consumption [13]. This study also used these eight items for measuring children’s curiosity toward food. For each question, the score ranged from “very often” response (4 points), “often” (3 points), “sometimes” (2 points), and to “never” (1 point). These questions are described in Appendix 2.

3. Survey Design and Implementation

1) Survey Design
Figure 1 explains how this survey was designed to assess educational impacts of Leçon du Goût. In the first study, observation research was conducted on some of the lessons of Leçon du Goût in order to contextualize the basic practice and to determine whether the lessons (i.e. programs) follow the Guidelines or not.

The observation methods included note-taking records of program contents, educators’ instruction, and children’s reactions and answers during the lessons. To assess whether the lessons basically followed the Guideline of Leçon du Goût, the recorded information was analyzed with a special focus on the six expected educational impacts discussed in Section 2. The three most important indicators for each impact category were identified based on the Guideline. These indicators are summarized in Table 3. In the second study an impact evaluation was conducted on one of the lessons before and after the program using the evaluation system described in the preceding section.

The questionnaire sheet containing the questions about educational impacts (1), (4), (5), and (6) (each number corresponds sub-section numbers in Section 2) was given to the children at pre/post program periods, and they answered the questions under the guidance of home class teachers. The children were also asked to write dietary records including answers about educational impacts (2) and (3) at the end of
school lunchtime for each of six days around the program without any teacher oversight.

2) Implementation and Data

The first survey was conducted on Leçon du Goût during La Semaine du Goût in October 2015. The target three lessons in Kyoto and Tokyo, where many Leçon du Goût are performed every year, were carefully selected through discussions with the host organization of this initiative. This study also considered the national culinary orientation of educators (Japanese, French, and Italian-Japanese chefs, and Japanese cooking expert), since the backgrounds of the educators can affect the program content to greater extent even if they are demanded to follow the basic Guideline.

The survey for the impact evaluation was carried out with 97 fifth-graders (aged 10-11 years) who participated in Leçon du Goût (Lesson A) in an elementary school in Kyoto by conducting the questionnaire and dietary record survey. The data for children who have allergies to some foods or could not answer all the questions in the questionnaire or dietary records for some reason were excluded for the analysis. A total of 81 students completed all the questionnaires, representing 83.5% of the total sample. A total of 63 students completed all the dietary records, representing 64.9% of the total sample.

4. Results and Discussion

1) Comparison and Analysis of the Lessons

The result of the observation research on the
three *Leçon du Goût* is summarized in Table 3. This result shows that at least two of the three essential components were definitively covered in all the impact categories. The observation research also suggests that a relatively insufficient coverage of Lesson C (in impact categories (1), (2), and (6)) might have been due to time constraints resulting not from tight time schedule but rather from an overly excited classroom atmosphere. The observation also revealed that the chef of Lesson A was more experienced than others in providing sensory education classes, and was able to cover and deepen more topics, especially in the impact categories (4) and (5). It turned out that, although educational impacts to some extent might be affected by educators’ ability or the nature of subject matters, the programs were basically being implemented following the Guideline.

Thus, it can be safely said that any of the three lessons can reasonably represent *Leçon du Goût* as long as careful consideration is given to educators’ performance and the class environment during the program. In addition, these findings confirmed that the educational impacts of Lesson A, which will be discussed in the following subsection, can be generalized overall for *Leçon du Goût* as long as they follow the Guidelines. The program detail of Lesson A is summarized in Table 4, with each program content and the educator’s instruction associated with specific educational impacts.

### 2) Identified Educational Impacts

This subsection analyzes educational impacts of Lesson A conducted in Kyoto on October 27th in 2015. Each score obtained in the evaluation before and after the program was statistically analyzed with SPSS (Version 20.0, level of significance: \( p < 0.05 \)).

#### (1) Understanding of Taste Mechanism

Since the educator did not mention ‘umami’ for this program, the score was calculated based on the other four basic tastes. A positive score was given even to misspelled or simplified answers as long as children were able to show where they should be attentive while tasting. The scores for understanding of taste mechanism were 1.16 at the pre-program and 3.16 at the post-program out of 5 for five senses,
and 0.63 at the post-program out of 5 for five senses, and 0.63 at the pre-program and 3.11 at the post-program out of 4 for four tastes. Thus, an increase was observed in the level of understanding of taste mechanism (five senses: \( t = 6.64, p < 0.05 \), basic tastes: \( t = 11.23, p < 0.05 \)). Although the acquisition of knowledge and understanding of taste mechanism is not the main objective of sensory education, this positive result may be associated with the nature of sensory education which both combines explicit learning (ex. information provision of taste mechanism) and implicit learning via tasting in class. In particular, this combination in class has been lacking in pre-existing nutrition education programs, in which children learned about nutrition through information in class but had to practice it at home or somewhere outside school, which often hinders the acquisition of knowledge.

(2) Food Differentiation

Since the majority of students did not consider rice, bread and milk as differentiating elements since they are always served in school meals, they were not taken into account when calculating scores. The total number of foods and seasonings, which are equivalent to the maximum score, were as follow: 13 for Day 1; 15 for Day 2; 16 for Day 3; 15 for Day 4; 19 for Day 5; and 12 for Day 6. A score was given based on the percentage of foods/seasonings correctly identified out of the total numbers for that day. For ambiguous answers, such as only “meat,” which can be considered beef, chicken, or pork, a half score was given; this rule also applied to egg (chicken egg, quail egg, etc.), potato (potato=Irish potato, sweet potato, taro, etc.), and beans (soybeans, red beans, etc.) (Appendix. 3).

The scores of food differentiation were 40.8 at the pre-program and 32.5 at the post-program out of 100. There was no significant difference in food differentiation scores between a pre-program and post-program period (\( t = 1.27, p = 0.21 \)). Rather, it seems that the score decreased during the program. This may perhaps be due to its demanding evaluation system where the children could not spend enough time to fully concentrate on dietary records since there was no teachers’ oversight during the evaluation and the children had difficulties in curbing their enthusiasm for the following break-time playground activities.

(3) Taste Expression

Here, we used taste expressions texts written by the children at the end of each school meals for the following analysis. The first analysis was made of the four basic tastes used for taste expression; these had been previously emphasized during the program. When counting the number of descriptive words, any type of form, whether nouns or adjectives (ex. sweetness or sweet), was taken into account as long as they referred to one attribute of the basic tastes. However, there was no increase in types and frequency of these words: At the pre-program period, sweet (25 times), sour (4), bitter (2), and salty (1) appeared while at the post-program period, sweet (10), sour (2), bitter (1), and salty (0) did.

The second analysis was made of all the nouns, adjectives, na-adjetives, and adverbs related to taste (see Table 5). However, there was also no significant increase in types and frequency of these words after the program, except for the word “oishii (delicious)” (\( t = 2.65, p < 0.05 \)). No significant change in most of the words may be partly due to the experimental constraint mentioned above, such as children’s detraction during unsupervised time.

However, interestingly, the increase in the subjective word “oishii” is consistent with a
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Table 5  Summary of Words Related to Taste Expression Used during School Meals

| Pre-Program | Type | Frequency | Post-Program | Type | Frequency |
|-------------|------|-----------|--------------|------|-----------|
| Nouns       |      |           |              |      |           |
| Amami (sweetness) (4) | | | Hagotae (texture) (3) | | |
| Fumi (flavor) (3) | | | Amami (sweetness) (2) | | |
| Kaori (aroma) (2) | 7 | 14 | | | |
| Umami (2) | | | | | |
| Nigami (bitterness) | | | | | |
| Sanami (sourness) | | | | | |
| Fushami (depth) | | | | | |
| Adjectives  |      |           |              |      |           |
| Oishii (delicious) (150) | 14 | 262 | Oishii (delicious) (155) | 3 | 5 |
| Bi (good) (39) | | | Bi (good) (23) | | |
| Amai (sweet) (21) | | | Amai (sweet) (7) | | |
| Yawaranhai (soft) (21) | | | Koi (intense) (7) | | |
| Koi (intense) (12) | | | Usui (weak) (2) | | |
| Karai (pungent) (5) | | | Yasashi (gentle) (2) | | |
| Usai (weak) (4) | 14 | 262 | Atakahi (warm) (14) | 204 |
| Suppai (sour) (3) | | | Ama-zuppai (sweet and sour) | | |
| Katai (hard) (2) | | | Karai (pungent) | | |
| Nigai (bitter) | | | Suppai (sour) | | |
| Komahai (small) | | | Ahurakdo (oily) | | |
| Shoppai (salty) | | | Nigai (bitter) | | |
| Mazai (bad) | | | Oh (many) | | |
| Moroi (fragile) | | | Shitsukoi (too much) | | |
| Na-adjectives (keiyo-doshi) | 4 | 5 | Gochu-gochu (mushy) (4) | 3 | 3 |
| Marigake (mushy) (2) | | | Gochu-gochu (mushy) (3) | | |
| Atsu-atsu (hot) | | | Creamy | | |
| Creamy | | | Karama (Pungent) | | |
| Adverbs     |      |           |              |      |           |
| Shashi-shahi (crispy) (20) | 11 | 45 | Shashi-shahi (crispy) (19) | 12 | 42 |
| Shikihari (heavy) (10) | | | Shikihari (heavy) (5) | | |
| Suppari (light) (6) | | | Suppari (light) (5) | | |
| Hono hono (spongy) (2) | | | Hono-hono (freshly-baked) (2) | | |
| Kori-kori (crunchy) | 11 | 45 | Kori-kori (crunchy) (2) | | |
| Pasa-pasa (dried) | | | Puri-puri (crispy) (2) | | |
| Puri-puri (fresh) | | | Toro-toro (thick) (2) | | |
| Tropi-tropi (thick) | | | Pasa-pasa (dried) | | |
| Tropi-puri (fresh) | | | Puri-puri (fresh) | | |
| Supha-supha (light and crispy) | | | Sato-sato (light) | | |
| Kito-kei (heavy) | | | Kito-kei (heavy) | | |
| Assari (light) | | | Assari (light) | | |

Note: The number besides each English translation indicates the frequency of the words. The analysis was made of the taste expression texts written by children after the school meals.

French research [13] showing that children described the tastes with subjective words rather than with objective words in the family-table context; nevertheless, other researchers have indeed reported children’s improved usage of objective words in the experimental situation.

The correlation between inclination toward subjective words and environments without any oversight, such as during everyday school lunch and family dinner, should be carefully scrutinized. However, there is some possibility that subjective expressions such as “oishii” contain different meanings before and after the program, which means that, in other words, the children might have perceived the food as “oishii” in different manners because of sensory education.

Thus, to investigate this, a third analysis was carried out concerning the expression “oishii” by conducting co-occurrence network analysis with KH Coder Ver. 2. Beta32 on it. Figure 2 shows that the network around the word “oishii” expanded after the program, since the number of words that co-occurred with “oishii” through other nodes increased from 14 to 35 between pre/post-program periods. This result suggests that the program enabled children to use more various and wider vocabularies in combination with “oishii.” This analysis also found that, both at pre/post-program periods, “oishii” strongly
co-occurred with words such as "niku-jaga (meat and potato stew),” “ama (sweet),” “curry,” “shaki-shaki (crispy),” and “aji (taste).”

In order to elucidate how “oishii” was actually used in taste expression phrases, this investigation of the term “oishii” continued with KWIC (Keyword in Context) concordance analysis on phrases that included the strongly co-occurring five words. A systematic review of all these phrases revealed the following five categories in which the children declared “oishii” : (1) texture, (2) combination, (3) taste intensity, (4) nature of taste and food, and (5) variation of taste (Table 6).

The result of this analysis showed that there was an increase only in the texture category after the program, suggesting that the program made it easier for them to perceive, whether consciously or unconsciously, something “oishii” based on its texture: crispiness or softness. It is too soon to conclude that the program changed children’s perception structure and taste expression only with this minor result. However, if combined with the result shown in Figure 2, it
can be safely said that the program to some extent enabled children to widen their taste expression.

(4) Taste Preference

The first analysis was made on children’s declarative preference for taste complexity and intensity. However, no change was observed (complexity: $t = 1.33, p = 0.18$, intensity: $t = 1.33, p = 0.18$): At the pre-program period, scores were 3.00 for complexity and 2.19 for intensity; at the post-program period, 2.93 for complexity and 2.28 for intensity.

A second analysis was conducted on answers of the open-ended questions with a focus on the basic four tastes (sweet, bitter, etc.), hotness, and taste intensity (Fig. 3, 4). After the program, there was an increase in unpleasantness associated with sourness ($t = 3.09, p < 0.05$) but a decrease in unpleasantness associated with taste weakness ($t = 2.57, p < 0.05$) (Fig 3, 4).

The decreased unpleasantness with weaker taste, or, increased linking for it was one of the intended impacts of sensory education, and this can be explained by guided sensory experience during the program where the children were instructed to be more conscious to subtle tastes and flavors in foods. However, interestingly, increased unpleasantness with sourness contradicts with the educational objective of sensory education, which aims to increase linking for sourness. This may have been due to the materials used for the program, only presenting vinegar as an example of sour food for guided tasting. More representative foods, such as lemon or orange, will perhaps serve as more educational materials for the guided tasting of sourness.

(5) Food Neophobia

AFNS usually consists of ten question items described in Appendix 1. However, in this study, they were reduced into eight items, excluding Q1. and Q7, so that the best internal consistency of these items could be obtained (Cronbach’s alpha 0.74, n=81, pre-program period). After the program, there was no significant increase in the revised AFNS between pre/post-program periods ($t = 1.33, p = 0.18$): The score was 4.17 at the pre-program period and 4.30 at the post-program period. This program used relatively familiar and ordinary foods, such as roasted...
pork and green tea flavored chocolate, for challenging children’s fear for novel foods and encouraging to try them, which might not have been sufficient to decrease children’s food neophobia. One possible way to actually decrease food neophobia would be to present more exotic or peculiar foods in the tasting session rather than ordinary foods.

(6) Curiosity toward Food
There was an increase in the score of curiosity toward food (Appendix 2) after the program ($t = 2.83, p < 0.05$): The score was 2.86 at the pre-program period and 3.02 at the post-program period. Two explanations can be made in terms of this increase in the curiosity. One is due to its ‘bottom-up’ educational pedagogy, in which children were asked to use their sensory systems and to arrive at their own answers, rather than the mere provision of answers by the educator. Another factor would be the unusual class environment, in which the children studied with food, not pencils and papers, and the class was given by the chef on behalf of the teacher. These two factors might have contributed to the increase in the curiosity. However, it must be noted that the internal consistency of the question items used was at best 0.61, while an internal consistency of 0.7 or higher is usually considered “reliable.”

5. Conclusion

Overall, this study aimed to evaluate educational impacts of Leçon du Goût in order to critically assess its potential as an alternative food education model. The observation research revealed that Leçon du Goût being conducted elsewhere in Japan basically followed consistent Teaching Guideline, ensuring its educational consistency. The impact evaluation research found that Leçon du Goût improves children’s understanding of taste mechanism, enhances their curiosity toward food, and leaves some minor implications for taste preference and taste expression. When dealing with these educational impacts, the following three points should be noted:

First, the improvement in children’s understanding of taste mechanism in this study is consistent with the results of Tokumaru’s study [6], but this type of cognitive impact is still within the framework of traditional intelligence-based nutrition education and does not achieve the main goals of sensory education relative to other educational pedagogy.

Second, there could be various interpretations of the concept of ‘curiosity toward food,’ due to few research attempts to define and measure it. Thus, the result of this study should be limited to describing the curiosity as “the ability of the eater to want to know everything that is related to food, whether at the stage of production, processing and consumption.”

Third, the internal consistency for the measurement tooling for curiosity toward food did not reach a “reliable” level, so its evaluation system should be improved for future studies.

Considerable research in France and other European countries have established evaluation system for 10-12 sessions of Classes du Goût. However, only a few studies have addressed impact evaluation for the shortened version of Classes du Goût, that is, Leçon du Goût, even though increasing budget allocations and human capitals have recently been invested in this initiative in Japan. In this sense, a critical assessment of Leçon du Goût is important, and this study was able to propose a basic evaluation system for Leçon du Goût under the constraints of a normal school environment where the laboratory-type evaluation, such as controlled sensory analysis, is not feasible. To further
improve this evaluation system, the following points should be considered:

First, before accurately measuring curiosity toward food, this should be operationally redefined based on the discourse in educational psychology. This is because “curiosity” used for sensory education research leaves too much space and inconsistency for interpretation; for example, this challenge is already visible when considering Beswick’s (1971) distinction between state and trait curiosity: the former refers to curiosity in a particular situation whereas the latter refers to a general capacity or propensity to experience curiosity [16]. Therefore, a proper evaluation system for curiosity toward food cannot be developed until we integrate perspectives of educational psychology.

Second, this study employed a pre-post evaluation design, since the limited preparation period did not allow for random-assignment design or even setting a control group, these features can be added in future studies. In addition, it is advisable to conduct the follow-up evaluation to assess its medium-term educational impacts on the children’s dietary behavior.

Finally, these findings suggest that the program duration should be extended in order to maximize the educational impacts to the level achieve by 10-12 sessions of Classes du Goût. Considering the real-world constraints for ensuring more food education classes in Japanese primary education, school lunchtime could be the most effective and realistic opportunity for additional Leçon du Goût classes, as recently practiced by some French organizations in Dijon [17].

Admittedly, the findings of this study can also be interpreted more critically. There is some possibility that the potential of Leçon du Goût will prove to be limited, even if evaluation methods are improved and additional resources are provided to maximize educational impacts. If this is the case, we have to reconsider the significance of Leçon du Goût. In other words, we have to scrutinize social aspects of Leçon du Goût, such as awareness-raising effects on chefs or parents, or establishment collaborative relationships between schools and these stakeholders, instead of relying solely on educational impacts.

In conclusion, Leçon du Goût improved children’s understanding of taste mechanism, enhances their curiosity toward food, and leaves some minor implications for their taste preference and taste expression. To maximize its educational impacts, it is important to consider how to systematically promote school-based sensory education in Japan as well as improve its evaluation methodology. Further studies are also needed to holistically comprehend the socio-cultural aspects of this type of evidence-based food education program.

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Note

(1) In Japanese the word umami can mean either the fifth taste of basic tastes, or “deliciousness,” and right now the former is becoming an internationally recognized term.

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Appendix 1  Description of the Items of the Adapted Food Neophobia Scale (AFNS)

| No. | Items of AFNS                                                                 |
|-----|------------------------------------------------------------------------------|
| 1   | I am very particular about the foods I will eat (reversed scoring)          |
| 2   | I like foods from different countries                                        |
| 3   | I don’t trust new foods (revised)                                           |
| 4   | I like to try unusual foods                                                  |
| 5   | If, for a food I have the choice between different flavors (ex: an ice-cream), I like to choose a flavor that I don’t know |
| 6   | I will try a dish, even if I do not know what is in it                       |
| 7   | The foods I know are sufficient for me (reversed)                            |
| 8   | I am willing to eat everything that one offers to me                         |
| 9   | I am afraid to eat things I have never had before (reversed)                 |
| 10  | I will not taste a food when I do not know what it is (reversed)             |

Source: Reverdy et al. (2008) [14]

Appendix 2  Description of the Items of Curiosity Toward Food

| No. | Items of Curiosity toward Food                                      |
|-----|---------------------------------------------------------------------|
| 1   | Do you like to go shopping with you mom (daddy) to buy food?        |
| 2   | Do you ask your mom (daddy) to buy food that you like to eat?       |
| 3   | Do you ask your mom (daddy) to buy food that you like the taste, odor, or texture? |
| 4   | Do you want to help your mom (daddy) to the kitchen to prepare the meals at home? |
| 5   | When you prepare or when you eat a food that you know, do you love to add new ingredients? |
| 6   | Do you like to talk about what you eat even if your mom (daddy) does not ask you the questions? |
| 7   | Do you like to know what’s in a dish (for example, the foods in chocolate bread or soup)? |
| 8   | When you eat at home, do you take the time to look, feel, and touch what you are going to eat? |

Source: Gaignaire et al. (2011) [13]

Appendix 3  Ingredient Table of School Lunch Menu during the Evaluation

| Ingredients                                                                 | Total |
|-----------------------------------------------------------------------------|-------|
| Day 1 Beef, onion, konnyaku, vegetable oil, sugar, sake, soy sauce, red kidney beans, carrot, cabbage, green asparagus, parched sesame, and ground sesame. | 13    |
| Day 2 Pork, potato, onion, vegetable oil, sugar, sake, curry powder, soy sauce, carrot, cabbage, sliced konbu, ground sesame, vinegar, agar, and apple. | 15    |
| Day 3 Beef, onion, carrot, canned tomato, vegetable oil, butter, wheat, barbeque sauce, Worcester sauce, salt, pepper, soy sauce, laurel canned tuna, sweet potato, olive oil, sugar, and vinegar. | 18    |
| Day 4 Pork, ginger, soy sauce, starch, vegetable oil, taro, onion, carrot, edamame, miso, sugar, sake, dried bonito, fried tofu, and Chinese cabbage. | 15    |
| Day 5 Tuna marinade, onion, carrot, ginger, dried shiitake, vegetable oil, sugar, mirin (sweet sake), sake, soy sauce, soybeans, tube-shaped fish paste cake, shredded dried lover, konnyaku, sliced konbu, spinach, salt, soup kelp, and dried bonito. | 19    |
| Day 6 Chicken, deep-fried fish paste ball, bean sprout, quail egg, Chinese radish leave, carrot, konnyaku, sugar, mirin (sweet sake), soy sauce, fried tofu, and dried bonito. | 12    |

Source: Developed by the author using the school meal menu given by the school dietitian.