

RELATIONSHIP AMONG STUDENTS' FACING PROBLEM RELATED MATHEMATICS LEARNING AND LESSON

Tomoko Nishikawa^{1*}, Guido Izuta²

Department of Social and Information Science, Yamagata Prefectural Yonezawa Women's Junior College
6-15-1 Toori Machi, Yonezawa City, Yamagata Prefecture, 992-0025 Japan

^{1*}nishikawa@yone.ac.jp, ²izuta@yone.ac.jp

Article History: Received on 07th January, Revised on 19th February, Published on 19th March 2019

Abstract

Purpose: The objective of this study is to examine the Japanese junior high school students' feelings of difficulty in learning mathematics and discuss a possible solution on the 'Lesson Study' framework.

Methodology: A survey was performed on 616 students of a public junior high school regarding their feelings towards learning mathematics. The survey was carried out at the end of the academic year 2016 in March, and 182 students (44 first-year, 75 second-year, 63 third-year) participated in the study. In this investigation, only those who answered "No Problem" were further scrutinized by means of conjoint analysis for their anxieties towards the specific learning modules following the education system guidelines and classified as 'Algebra calculations', 'Functions' and 'Geometrical figures'. Basically, the analysis consisted of assessing these students' awareness of 'being good at' and 'being not good at' one specific module relative to the other modules. Data processing and conjoint analysis were performed with Microsoft Excel.

Main Findings: Roughly 68% of first year students, 77% of second year female students, and 72% of third year female students felt 'Not Good At' towards 'Algebra calculation' and 'Functions', whereas about 95% of second year male students self-assessed themselves as 'Not Good At' towards 'Functions', and 79% of third year males as 'Good At' towards 'Algebra calculation'. Thus, even though some students declared "No Problem", they were actually 'Not Good At'.

Implications: These findings suggest that a class division according to the students' feelings with 'Lesson Study' at the teachers' level would help struggling students to learn mathematics. In addition, we showed that the use of conjoint analysis-based assessment may help educators and teachers to figure out students' feelings towards learning mathematics.

Novelty: The use of conjoint analysis to analyze the students' implicit feelings towards learning mathematics is followed by a discussion on the grounds of 'Lesson Study', for which a cycle at the individual level is presented.

Keywords: *Mathematics Learning, Japanese Junior High School Education, Lesson Study, Learning Anxiety*

INTRODUCTION

Difficulties faced in classes by learners of mathematics are among the biggest issues that teachers are concerned about in their daily job activities. It is not uncommon to roughly classify mathematics students into three groups; namely, 'being not good at', 'being good at', and 'neutral' ("No Problem"). Also, 'being not good at' and 'being good at' groups are outstanding in class and catch teachers' attention more frequently. This probably happens due to the fact that the characteristics of the 'neutral' group are not fully understood in the sense that their anxieties towards specific learning modules are not known.

Motivated by these facts, this paper focuses on Japanese junior high school students with no self-assessed feelings of difficulty towards learning mathematics. The study is based on the conjoint analysis with three attributes, each with two levels. The attributes are the learning modules defined in the course of study, which were labeled as 'Algebra calculations', 'Functions', and 'Geometrical figures', and these were in turn evaluated by the levels given by 'Good At' and 'Not Good At'. It is worth noting that there the authors have investigated the attitudes of students towards learning mathematics without considering their 'goodness at' in previous reports ([Izuta & Nishikawa, 2017](#); [Nishikawa & Izuta, 2017](#); [Nishikawa & Izuta, 2018](#)) and suggested that there are gender and academic year-dependent trends in the learning anxiety among students. The results are discussed on the grounds of the 'Lesson Study' framework, for which we provide an implementation cycle at the individual level.

As a matter of fact, 'Lesson Study' is an educational system developed in Japan to improve teaching skills and pedagogical abilities of teachers ([Doig & Groves, 2011](#); [Fujii, 2015](#); [Lewis, 2013](#); [Takahashi, 2006](#)). Its long history makes it a very popular off-duty activity ([Isoda, 2010](#); [Arani, Fukaya, & Lassegard, 2010](#)) that Japanese teachers are somehow engaged to whether at the national implementation level, or at the municipal board of education committees level, or at the local school level ([Fujii, 2015](#); [Lewis, 2013](#)). The core activity consists of group activity involving a cyclic process of planning (preparations), doing (observations and class inspection), and seeing (discussion and reflection) with other teachers by means of meetings and workshops during the academic terms with the main purpose of developing *Kyouzaikenkyu*, a research of instructional materials ([Fujii, 2015](#); [Ebaeguinn & Stephens, 2016](#); [Isoda, 2010](#)). Moreover, in recent years, an increasing number of countries have experimentally introduced 'Lesson Study' and its concepts have been extended ([Fujii, 2014](#); [Farhoush, Majedi, & Behrangi, 2017](#); [Kadron & Inprasitha, 2013](#); [Lu & Lee, 2012](#); [Perry & Lewis, 2009](#)). For example, [Ebaeguinn and Stephens \(2016\)](#) summarized some key elements in the planning of a good mathematics lesson and discussed its importance for teachers of Japanese junior high school mathematics to research and use teaching materials and other resources developed in their lessons.

Now, as far as the students' feelings of difficulty in learning the subject of mathematics is concerned, the students can roughly be classified into three groups: 'being not good at', 'being good at', and 'neutral' ("No Problem"). In general, teachers focus more on 'being not good at' or 'being good at' groups. The 'neutral' group, however, is less noticeable because its characteristics are difficult to understand. In other words, it is unknown whether or not the students belonging to the 'neutral' group are good at mathematics. Thus, in this research, we focus on this group to provide some useful information that will help in improving 'Lesson Study'. This study is motivated by the authors' previous research that examined the feelings of junior high school students towards three main areas of mathematics learning and showed a trend dependent on gender and grades ([Izuta & Nishikawa, 2017](#); [Nishikawa & Izuta, 2017](#); [Nishikawa & Izuta, 2018](#)). In this paper, we focus only on students who feel "No Problem" towards learning mathematics. These students are grouped according to a method based on the conjoint analysis. By classifying it into small groups, we further figure out the characteristics of the group. Students' feelings for learning mathematics in three major areas are examined by using conjoint analysis.

METHODOLOGY

Sample Size

Before starting a survey, we asked the principal of a public junior high school in Niigata Prefecture for survey cooperation and got permission from the principal to carry out the survey. The survey was carried out at the end of the term of the academic year 2016 in March. In all, 616 students of a typical public junior high school (182 first-year, 212 second-year, and 222 third-year) aged 12 to 15 years answered a survey assessing their feelings towards learning mathematics according to a five-point Likert scale ('not good at', 'somewhat not good at', 'neutral', 'somewhat good at', and 'good at'). Only respondents who answered 'Neutral' ("No Problem") were selected for this study and the number was 182 respondents (44 first-year, 75 second-year, and 63 third-year). These students then participated in a conjoint analysis-based survey, which consisted of three attributes ('Algebra calculations', 'Functions' and 'Geometrical figures'), each with two levels ('Good At' and 'Not Good At').

Research Design and Data Collection

The details of the statistical procedures can be found in the authors' previous paper ([Nishikawa & Izuta, 2017](#)). In brief, firstly, the 'Neutral' group respondents were asked to rank up the conjoint cards from number 1 (fulfilling or closest to what they think or feel) through number 4 (less applicable) as shown in Figure 1. Secondly, these respondents were clustered by gender and academic year by using a clustering method ([Izuta, Nishikawa, & Nakagawa, 2016](#)). Table 1 shows the clustered groups.

Data Processing

The clustered groups were analyzed with traditional conjoint analysis method with Microsoft Excel 2013 ([Orme, 2014](#)), R version 3.5.2, which is at-once statistical analysis application and open source type of software ([R Core Team, 2018](#)) and several packages ([Wickham, 2016](#); [Wickham, 2017](#); [Wickham, 2018](#); [Wilke, 2019](#)) were used for the visualization of the conjoint analysis results.

	Algebra calculations	Geometrical figures	Functions	Ranking
Card 1	Good At	Good At	Good At	
Card 2	Good At	Not Good At	Not Good At	
Card 3	Not Good At	Good At	Not Good At	
Card 4	Not Good At	Not Good At	Good At	

Figure 1. Conjoint Cards Used in the Survey

Table 1: Characteristics of the Clustered Groups

Clustered Group	First Year				Second Year				Third Year			
	Male (n = 17)		Female (n = 27)		Male (n = 37)		Female (n = 38)		Male (n = 29)		Female (n = 34)	
	n	%	n	%	n	%	n	%	n	%	n	%
G1	7	41.2	11	40.7	13	35.1	16	42.1	12	41.4	9	26.5
G2	3	17.6	6	22.2	9	24.3	8	21.1	6	20.7	9	26.5
G3	2	11.8	4	14.8	6	16.2	8	21.1	5	17.2	6	17.6
G4	2	11.8	3	11.1	5	13.5	2	5.3	3	10.3	3	8.8
G5	2	11.8	3	11.1	2	5.4	2	5.3	2	6.9	3	8.8
G6	1	5.9	—	—	2	5.4	2	5.3	1	3.4	3	8.8
G7	—	—	—	—	—	—	—	—	—	—	1	2.9

RESULTS

Characterization of First Year Students

Figure 2 presents the results of conjoint analysis for all groups of first year students. The precision of measurement (R2) in the conjoint analysis for males were 0.80, 0.91, 1.00, 0.90, and 0.90 for the groups G1 through G5, respectively. The R2 value of group G6 cannot be calculated, because it has only one element. For females, the R2 values for groups G1 to G5 were 0.79, 0.91, 1.00, 1.00, and 0.11, respectively. Table 2 summarizes the main points of the results for the first year students. As clearly seen in Figure 2(A) and Figure 2(B), males and females had similar graphical patterns for groups G1 through G3. The values of importance and relative partial utilities for males in group G1 were 57.1% for 'Functions' with 'Not Good At (Functions)', 33.3% for 'Algebra calculation' with 'Not Good At (Algebra calculation)', and 9.5% for 'Geometrical figures' with 'Good At (Geometrical figures)', whereas females ranked 54.5% for 'Functions' with 'Not Good At (Functions)', 36.4% for 'Algebra calculation' with 'Good At (Algebra calculation)', and 9.1% for 'Geometrical figures' with 'Good At (Geometrical figures)'. Now, the second largest group G2 of males and females focused mainly on 'Algebra calculation' with importance value of 66.7%, 'Geometrical figures' with 22.2%, and 'Functions' with 11.1%, in which the attribute levels of males were 'Good At (Algebra calculation)', 'Not Good At (Geometrical figures)' and 'Not Good at (Functions)', whereas females were 'Not Good At (Algebra calculation)', 'Not Good At (Geometrical figures)' and 'Good at (Functions)', respectively. Yet G3 of males and females measured 66.7% of importance for 'Functions' and 33.3% for 'Algebra calculation' and their respective attribute levels were 'Not Good At (Functions)' and 'Good At (Algebra calculation)'.

As shown in Figure 2(A), males in G4 and G5 had both importance 50.0% for 'Algebra calculation' with 'Not Good At' (Algebra calculation). In addition, while G4 marked 50.0% for 'Geometrical figures' assessed as 'Good At' (Geometrical figures), G5 counted 50.0% for 'Functions' defined by 'Good At (Functions)'. The importance of attribute for G6 marked 66.7% for 'Geometrical figures' and 33.3% for 'Functions' while their dominant attribute levels were 'Not Good At (Geometrical figures)' and 'Not Good At (Functions)'.

For females, it can be seen from Figure 2(C) that the graphs of importance for G4 and G5 had similar patterns. Both groups gave 'Geometrical figures' with 66.7% and 'Function' with 33.3% of importance. These attributes of G4 were represented by the attribute levels given by 'Not Good At' (Geometrical figures) and 'Not Good At' (Functions); G5 had 'Good At (Geometrical figures)' and 'Good At' (Functions).

Table 2: Summary of the results in first year students

Clustered Group	Male				Female			
	Algebra calculations	Functions	Geometrical figures	n (%)	Algebra calculations	Functions	Geometrical figures	n (%)
G1	Not Good At	Not Good At	Good At	41.2	Not Good At	Not Good At	Good At	40.7
G2	Good At	Not Good At	Not Good At	17.6	Not Good At	Good At	Not Good At	22.2
G3	Good At	Not Good At	—	11.8	Good At	Not Good At	—	14.8
G4	Not Good At	—	Good At	11.8	—	Not Good At	Not Good At	11.1
G5	Not Good At	Good At	—	11.8	—	Good At	Good At	11.1
G6	—	Not Good At	Not Good At	5.9	—	—	—	—

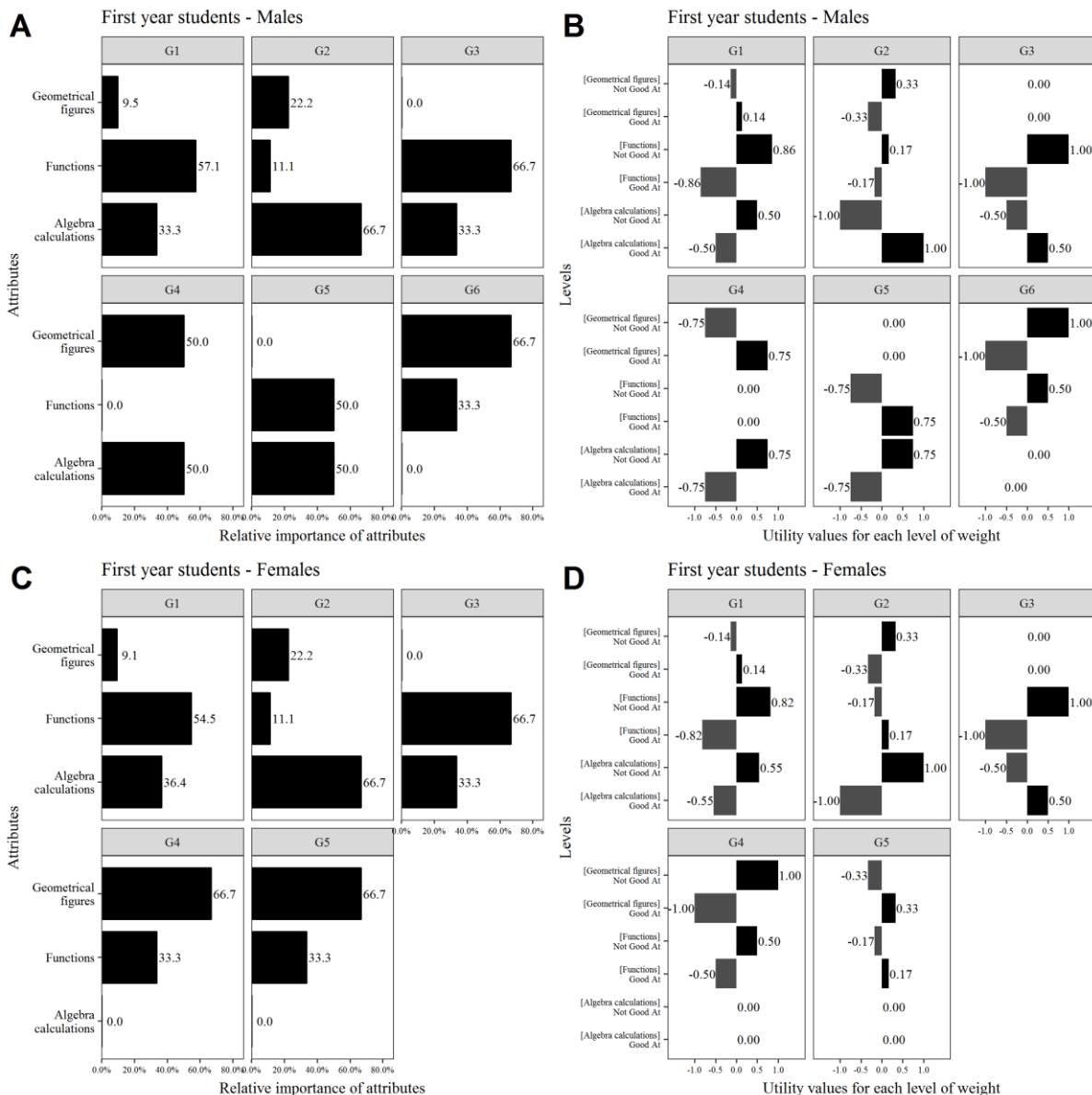


Figure 2. Comparison of conjoint analysis for all the groups of first year students. (A) Relative importance of attributes of males. (B) Partial utility values of groups of males. (C) Relative importance of attributes of females. (D) Partial utility values of groups of females.

From the results, we found that the largest groups G1s of first year students considered ‘Functions’ as the most important area and felt ‘Algebra calculation’ and ‘Functions’ to be ‘Not Good At’. Thus, a significant proportion of the first year students felt ‘Not Good At’ towards ‘Algebra calculation’ and ‘Functions’.

Characterization of Second Year Students

The importance and partial utility value graphs for all groups of second year students are shown in Figure 3. The R2 for males were 0.77, 0.79, 0.94, 0.87, 1.00, and 0.60 for groups G1 to G6, respectively. In turn, R2 for females were 0.86, 0.91, 0.86, 1.00, 1.00, and 0.70 for groups G1 to G6, respectively. The results obtained from the conjoint analysis of second year students are summarized in Table 3. From the relative importance graph (Figure 3(A)), it is clear that the largest group G1 of males focused mainly on ‘Functions’ with 65.7%, ‘Algebra calculation’ with 31.4%, and ‘Geometrical figures’ with 2.9% of importance, in which their attribute levels are ‘Not Good At (Functions)’, ‘Good At (Algebra calculation)’, and ‘Not Good At (Geometrical figures)’. As seen in Figure 3 (C), the graphical patterns of the importance graphs of G1 of female students resemble pretty much the ones found for group G1 of males. G1 of females ranked 72.7% for ‘Functions’ with ‘Not Good At’ (Functions), 18.2% for ‘Algebra calculation’ with ‘Not Good At’ (Algebra calculation), and 9.1% for ‘Geometrical figures’ with ‘Good At’ (Geometrical figures). In addition, G2 of males and females had similar graphical patterns. The attributes for G2 of males ranked 64.0% for ‘Algebra calculation’, 32.0% for ‘Functions’, and 4.0% for ‘Geometrical figures’, while their representative attribute levels were ‘Not Good At (Algebra calculation)’, ‘Not Good At (Functions)’, and ‘Good At (Geometrical figures)’; G2 of females marked 54.2% for ‘Algebra calculation’ with ‘Good At (Algebra calculation)’, 45.8% for ‘Functions’ with ‘Not Good At (Functions)’.

Furthermore, with regard to males (Figure 3(A)), G3 was characterized by 66.7% of importance value for ‘Geometrical figures’, 27.8% for ‘Functions’, and 5.6% for ‘Algebra calculation’, with corresponding partial utility being ‘Good At (Geometrical figures)’, ‘Not Good At (Functions)’, and ‘Good At (Algebra calculation)’; G4, whose importance graph pattern was similar to G3, by 76.9% for ‘Geometrical figures’ with level ‘Not Good At (Geometrical figures)’, and 23.1% for ‘Functions’ with level ‘Not Good At (Functions)’. G5 had 66.7% of importance for ‘Algebra calculation’ with ‘Good At (Algebra calculation)’, and 33.3% for ‘Geometrical figures’ with ‘Good At (Geometrical figures)’. Finally, G6 marked 33.3% for all attributes, in which the attributes levels were ‘Not Good At (Geometrical figures)’, ‘Good At (Functions)’ and ‘Good at (Algebra calculation)’, respectively.

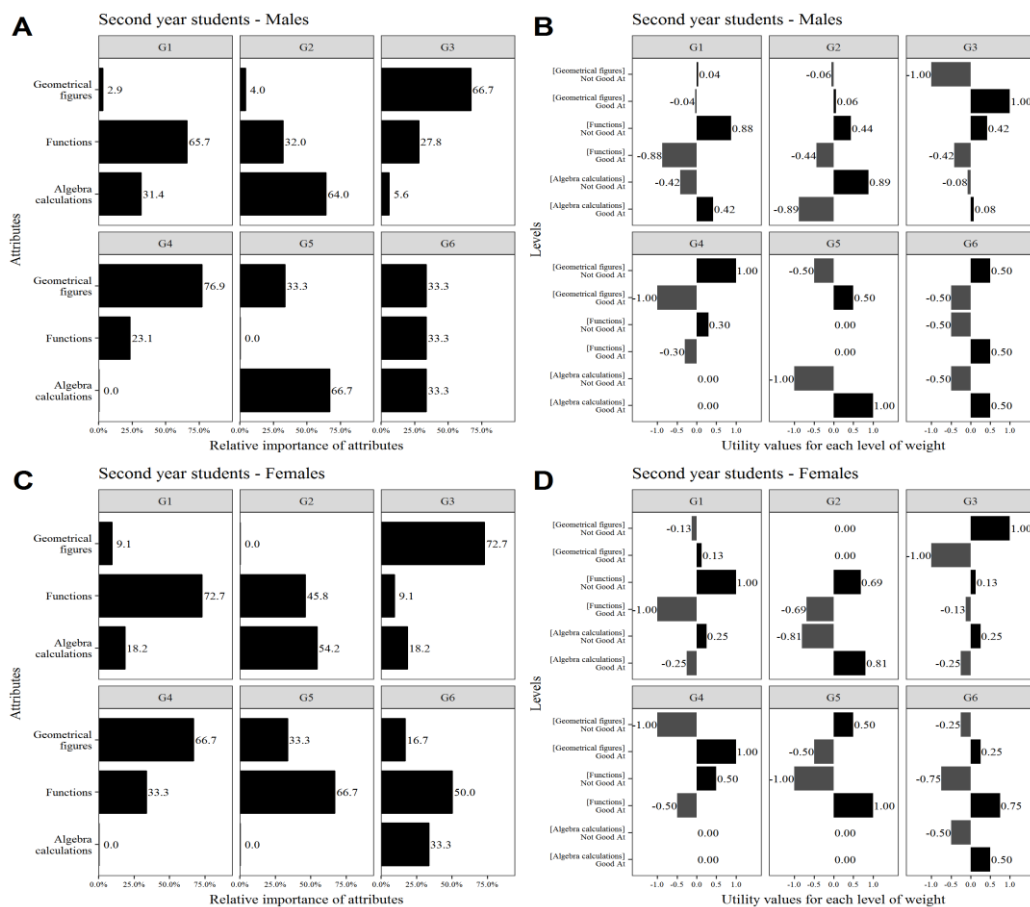


Figure 3. Comparison of conjoint analysis for all groups in second year students. (A) Relative importance of attributes of males. (B) Partial utility values of groups of males. (C) Relative importance of attributes of females. (D) Partial utility values of groups of females.

Table 3: Summary of the results in second year students

Clustered Group	Algebra calculations	Male			Female			
		Functions	Geometrical figures	n (%)	Algebra calculations	Functions	Geometrical figures	n (%)
G1	Good At	Not Good At	Not Good At	35.1	Not Good At	Not Good At	Good At	42.1
G2	Not Good At	Not Good At	Good At	24.3	Good At	Not Good At	—	21.1
G3	Good At	Not Good At	Good At	16.2	Not Good At	Not Good At	Not Good At	21.1
G4	—	Not Good At	Not Good At	13.5	—	Not Good At	Good At	5.3
G5	Good At	—	Good At	5.4	—	Good At	Not Good At	5.3
G6	Good At	Good At	Not Good At	5.4	Good At	Good At	Good At	5.3

Next, with respect to female students (Figure 3(C)), the attributes for G3 ranked 72.7% for ‘Geometrical figures’, 27.6% for ‘Functions’, and 18.2% for ‘Algebra calculation’ while their dominant attribute levels were ‘Not Good At (Geometrical figures)’, ‘Not Good At (Functions)’ and ‘Not Good At (Algebra calculation)’. The importance values of attributes in G4 and G5 were both zeros for ‘Algebra calculation’, although their graphical pattern of the attribute differed from each other. The graphical pattern of the attribute levels also differed between G4 and G5. Finally, group G6 had importance 50.0% for ‘Functions’ assessed as ‘Good At (Functions)’, 33.3% for both ‘Algebra calculation’ with ‘Good At (Algebra calculation)’, and 16.7% for ‘Geometrical figures’ with ‘Not Good At’ (Geometrical figures), representing their respective attributes.

From the results, we found that the largest groups G1s in second year students considered ‘Functions’ as the most important learning module; and evaluated it as ‘Not Good At’. A significant proportion of second year female students felt ‘Not Good At’ towards ‘Algebra calculation’ and ‘Functions’, whereas a significant number of male students considered ‘Functions’ to be ‘Not Good At’.

Characterization of Third Year Students

Figure 4 indicates the conjoint analysis of all groups of third year students. The R2 for males were 0.88, 0.83, 0.94, 0.91, and 1.00 for the groups G1 through G5, respectively; and for females they were 0.79, 0.87, 0.91, 0.91, 0.78, and 0.78 for the groups G1 through G6, respectively. It is unreasonable to compute the values of R2 values for group G6 of males and group G7 of females, due to the insufficiency of elements. Table 4 gives the summary of the results for third year students. As shown in Figure 4(A), for the largest group G1 of males, the attribute with the highest importance value was ‘Algebra calculation’ (67.6%), which had the level ‘Good At’ (Algebra calculation) representing it. The second largest attribute was ‘Geometrical figures’ with 29.4%, for which the relevant attribute level was ‘Good At’ (Geometrical figures). Similar to G1, the values of the attributes in G3 and G5 increased following the order given by ‘Geometrical figures’ and ‘Algebra calculation’. Looking at the levels of attributes, they both had ‘Not Good At’ (Geometrical figures) for attribute ‘Geometrical figures’ and differed for attribute ‘Algebra calculation’, in which the attribute level of G3 had ‘Good At’ (Algebra calculation), whereas G5 was ‘Not Good At’ (Algebra calculation). Furthermore, the graphs of importance for G2, G4, and G6 had similar patterns. The attributes for G2 ranked 55.6% for ‘Functions’, 38.9% for ‘Geometrical figures’, and 5.6% for ‘Algebra calculation’, while their representative attribute levels were ‘Not Good At’ (Functions), ‘Not Good At’ (Geometrical figures), and ‘Good At’ (Algebra calculation); G4 measured 55.6% for ‘Functions’ with ‘Not Good At’ (Functions), and 44.4% for ‘Geometrical figures’ with ‘Good At’ (Geometrical figures); G6 marked 66.7% for ‘Functions’ with ‘Good At’ (Functions), 33.3% for ‘Geometrical figures’ with ‘Good At’ (Geometrical figures).

As for the third year female students (shown in Figure 4(C) and Table 4), G1 and G2 both had the same percentages of respondents, namely, 26.5%. G1 had 64.0% of importance for ‘Geometrical figures’ with ‘Not Good At’ (Geometrical figures) as its level, 32.0% for ‘Functions’ with ‘Not Good At’ (Functions), and 4.0% for ‘Algebra calculation’ with ‘Not Good At’ (Algebra calculation). G2 came up with 72.0% of importance for ‘Algebra calculation’ with ‘Good At’ (Algebra calculation), 20.0% for ‘Geometrical figures’ with ‘Not Good At’ (Geometrical figures), and 8.0% for ‘Functions’ with ‘Not Good At’ (Functions). Next, the importance value chart of group G3 was similar to the one of G7. The importance values of attributes in G3 and G7 were both zeros for ‘Geometrical figures’, although their graphical patterns of the attribute levels differed from each other. G4 also had zeros for ‘Functions’ and the values of importance and relative partial utilities were 55.6% for ‘Algebra calculation’ with ‘Good At’ (Algebra calculation) and 44.4% for ‘Geometrical figures’ with ‘Good At’ (Geometrical figures). Lastly, for the group G5, the figures were 55.6% for

‘Geometrical figures’ with ‘Good At’ (Geometrical figures), 33.3% for ‘Algebra calculation’ with ‘Not Good At’ (Algebra calculation), and 11.1% for ‘Functions’ with ‘Not Good At’ (Functions), whereas G6 measured 55.6% for ‘Functions’, 33.3% for ‘Algebra calculation’, and 11.1% for ‘Geometrical figures’, and their respective attribute levels were ‘Not Good At’ (Functions), ‘Not Good At’ (Algebra calculation) and ‘Good At’ (Geometrical figures).

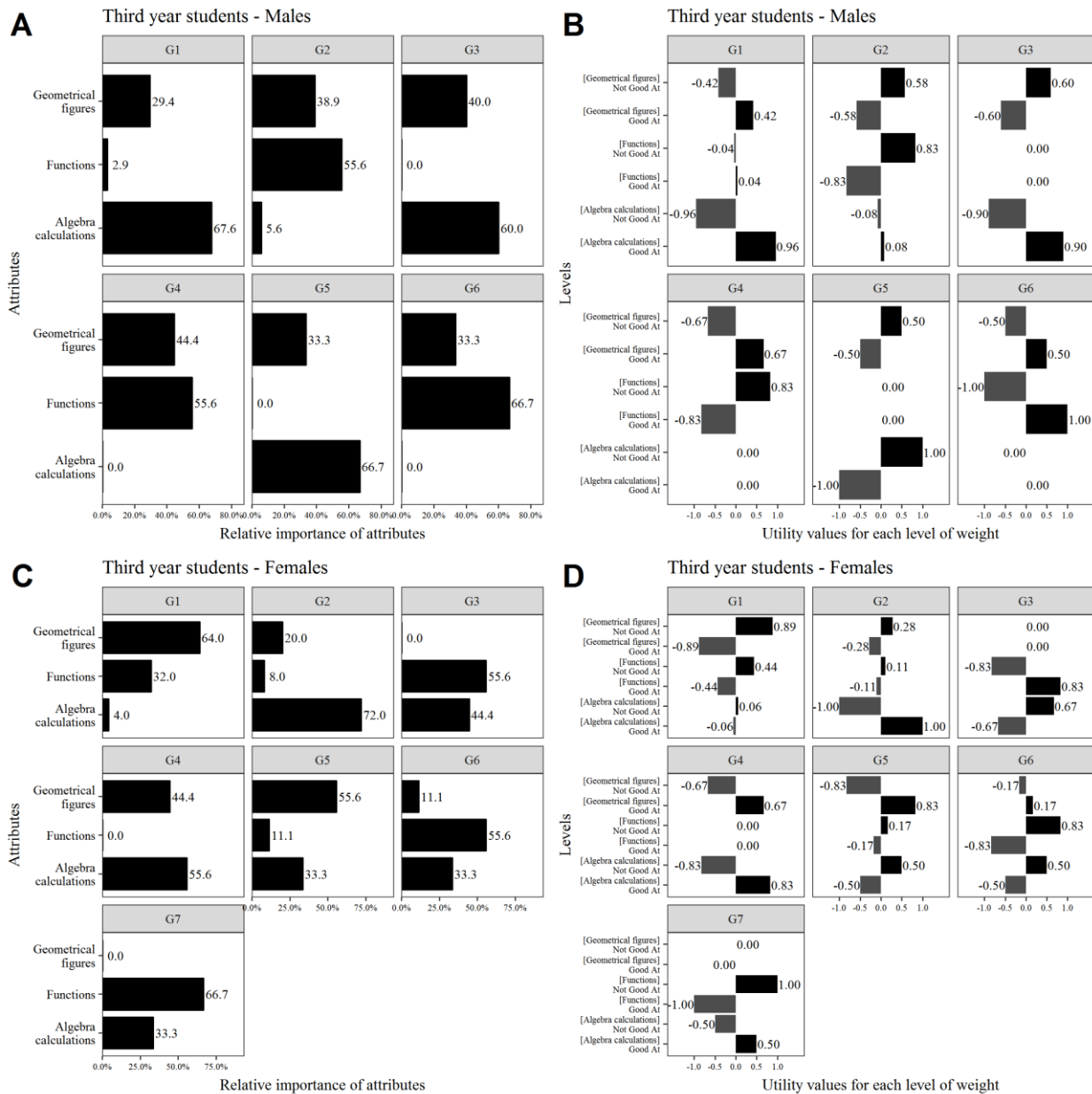


Figure 4. Comparison of conjoint analysis for all the groups in third year students. (A) Relative importance of attributes of males. (B) Partial utility values of groups of males. (C) Relative importance of attributes of females. (D) Partial utility values of groups of females.

Table 4: Summary of the results in third year students

Clustered Group	Male				Female			
	Algebra calculations	Functions	Geometrical figures	n (%)	Algebra calculations	Functions	Geometrical figures	n (%)
G1	Good At	Good At	Good At	41.4	Not Good At	Not Good At	Not Good At	26.5
G2	Good At	Not Good At	Not Good At	20.7	Good At	Not Good At	Not Good At	26.5
G3	Good At	—	Not Good At	17.2	Not Good At	Good At	—	17.6
G4	—	Not Good At	Good At	10.3	Good At	—	Good At	8.8
G5	Not Good At	—	Not Good At	6.9	Not Good At	Not Good At	Good At	8.8

Clustered Group	Algebra calculations	Male			Female			
		Functions	Geometrical figures	n (%)	Algebra calculations	Functions	Geometrical figures	n (%)
G6	—	Good At	Good At	3.4	Not Good At	Not Good At	Good At	8.8
G7	—	—	—	—	Good At	Not Good At	—	2.9

From the results, we found that the largest group G1 in third year male students considered ‘Algebra calculation’ to be the most important learning module, i.e., they felt ‘Algebra calculation’ to be ‘Good At’. On the other hand, third year female students had two largest groups, namely G1 and G2. The most important module for G1 was ‘Geometrical figures’ and they felt ‘Geometrical figures’ to be ‘Not Good At’; and the most important module for G2 was ‘Algebra calculation’ and they felt ‘Good At’ towards ‘Algebra calculation’. A significant proportion of females felt ‘Not Good At’ towards ‘Algebra calculation’ and ‘Functions’, whereas a significant proportion of males considered ‘Algebra calculation’ to be ‘Good At’.

DISCUSSION

One of the relevant findings was that students with characteristics that would place them into the group ‘Not Good At’ mathematics were in the “No Problem” group. Thus, there are students who think that even though they think “mathematics learning is not an issue”, the attitudes and feelings towards particular learning modules show that they are in fact part of the other group. Another interesting result is that almost 60% of the total students in “No Problem” yielded ‘Not Good At’ for two or more of the three major learning modules of mathematics classes. In addition, a significant number of students, both males and females in all grades, felt ‘Not Good At’ with respect to ‘Functions’, the proportions of second year boys and girls as well as third year girls were higher than others. These findings suggest that special emphasis on ‘Functions’ module is needed for advanced students and teachers need to understand that there is a discrepancy between the students’ perceptions and their awareness of weaknesses in mathematics learning. The latter also means that whenever possible, teachers have to find ways to introduce these points in the ‘Lesson Study’ and develop materials to help students in unmatched groups to get over their implicit learning anxieties.

Even though students feel that “mathematics learning is not an issue”, changes in their feelings may occur in future. Various kinds of learning situations appear in mathematics learning and they can change the students’ motivation, which may be either for bad or for good. Obviously, the teachers’ mission is to make it for good for the students and the motivation and enthusiasm of teachers in every single lesson will in turn have a huge impact on the students’ motivation and feelings. One ideal approach would be narrowing down the ‘Lesson Study’ to individual levels and put into practice before, during, and after each class. However, the time necessary for this endeavor trades off with the already busy time that teachers spend on their daily responsibilities. Hence, we recommend that a conjoint analysis-like survey be performed at the beginning of the academic term and group the students according to their assessments among other things, at an individual or at a larger level, and go constantly through the following cycle: (1) plan a fair amount of guidance points for each lesson; (2) develop, research, and use a variety of teaching materials and textbooks in class; (3) review the contents of instructions after each class and make sure to reflect it in the next class and lesson; and (4) pay detailed attention to and cope adequately with the students’ attitudes and behavior towards the class lessons.

CONCLUSIONS

This work is concerned with the assessment of perceptions of difficulty that Japanese junior high school students have towards the three major modules of mathematics learning. The focus was on students who think that “mathematics learning is not an issue”. It turned out that students with ‘being not good at’ in mathematics learning were also in “No Problem” group, despite the students’ perceptions. The results indicate that if a class division is according to the students’ assessment and mathematical reasoning maturity, then teachers need to at least recognize the number of students who are not good at mathematics. On the top of that, teachers need to conduct a careful research on the teaching materials on a daily basis following a cycle of extended ‘Lesson Study’ as proposed in the present study. Finally, as a by-product, we can say that the use of conjoint analysis-based assessment may help educators and teachers to figure out the level of anxiety that students have towards learning mathematics.

ACKNOWLEDGEMENT

This work was financially supported by Yamagata Prefectural Yonezawa Women’s Junior College Fund for Individual Research.

REFERENCES

- Arani, M. R. S., Fukaya, K., & Lassegard, J. P. (2010). "Lesson Study" as Professional Culture in Japanese Schools: An Historical Perspective on Elementary Classroom Practices. *Nichibunken Japan Review*, 22, 171–200.
- Doig, B., & Groves, S. (2011). Japanese lesson study: Teacher professional development through communities of inquiry. *Mathematics Teacher Education and Development*, 13(1), 77–93.
- Ebaegu, M., & Stephens, M. (2016). Key Elements of a Good Mathematics Lesson as Seen by Japanese Junior High School Teachers. In *Proceedings of the 39th annual conference of the Mathematics Education Research Group of Australasia*. 206–213.
- Farhoush, M., Majedi, P., & Behrangi, M. (2017). Application of Education Management and Lesson Study in Teaching Mathematics to Students of Second Grade of Public School in District 3 of Tehran. *International Education Studies*, 10(2), 104–113.
- Fujii, T. (2014). Implementing Japanese Lesson Study in Foreign Countries : Misconceptions Revealed. *The Mathematics Teacher Education and Development Journal*, 16(1), 65–83.
- Fujii, T. (2015). The Critical Role of Task Design in Lesson Study. In A. Watson & M. Ohtani (Eds.), *ICMI Study 22: Task design in mathematics education*. Switzerland: Springer. 273–286.
- Isoda, M. (2010). Lesson Study: Japanese Problem Solving Approaches. In *APEC Conference on Reaplicating Exemplary Practices in Mathematics Education*, Koh Samui.
- Izuta, G. & Nishikawa, T. (2017). Assessing the Sense of 'Good at' and 'Not Good At' towards Learning Topics of Mathematics with Conjoint Analysis. *AIP Conference Proceedings* 1847, 030014-1–030014-7. doi:10.1063/1.4983892.
- Izuta, G., Nishikawa, T., & Nakagawa, M. (2016). A Conjoint Analysis-Based Grouping Strategy for a Metacognitive Study Aimed to Assess Students' Feeling of Difficulty towards Learning. In *Conference Proceedings of 2016 Hong Kong International Conference on Education, Psychology and Society (5th HKICEPS)*, CD-ROM Format, Hong Kong, China, December 14-16, 189–200.
- Kadron, T., & Inprasitha, M. (2013). Professional Development of Mathematics Teachers with Lesson Study and Open Approach: The Process for Changing Teachers Values about Teaching Mathematics. *Psychology*, 4(2), 101–105.
- Lewis, C. C. (2013). How Do Japanese Teachers Improve their Instruction? Synergies of Lesson Study at the School, District and National Levels. *Commissioned Paper: The National Research Council Board on Science Education*.
- Lu, P. C., & Lee, P. Y. (2012). A Singapore Case of Lesson Study. *The Mathematics Educator*, 21(2), 34–57.
- Nishikawa, T. & Izuta, G. (2017). A Characterization of Junior High Students with Anxieties towards Learning Mathematics, In *Proceedings of 2017 International Conference on Education, Psychology, and Social Sciences*, CD-ROM Format, Bangkok, Thailand, August 2–4, 404–413.
- Nishikawa, T. & Izuta, G. (2018). A Look into the 'No Problem' Feeling Towards Studying Major Areas of Mathematics Among Japanese Junior High School Students. *Bulletin of Yonezawa Women's Junior College*. 54, 103-110.
- Orme, B. K. (2014). *Getting Started with Conjoint Analysis: Strategies for Product Design and Pricing Research* (third edition), Research Publishers, Chicago, IL.
- Perry, R. R., & Lewis, C. C. (2009). What is successful adaptation of lesson study in the US?. *Journal of Educational Change*, 10(4), 365–391.
- R Core Team (2018). *R: A language and environment for statistical computing*. R Foundation for Statistical Computing, Vienna, Austria. Retrieved from <https://www.R-project.org/>. (accessed 2019-05-08).
- Takahashi, A. (2006). Characteristics of Japanese Mathematics Lessons. *Tsukuba Journal of Educational Study in Mathematics*, 25(1997), 37–44.
- Wickham, H. (2016). *ggplot2: Elegant Graphics for Data Analysis*. Springer-Verlag New York. Retrieved from <https://ggplot2.tidyverse.org/>. (accessed 2019-05-08).
- Wickham, H. (2017). *tidyverse: Easily Install and Load the 'Tidyverse'*. R package version 1.2.1. Retrieved from <https://www.tidyverse.org/>. (accessed 2019-05-08).
- Wickham, H. (2018). *scales: Scale Functions for Visualization*. R package version 1.0.0. Retrieved from <https://www.R-project.org/>. (accessed 2019-05-08).
- Wilke, Claus O. (2019). *cowplot: Streamlined Plot Theme and Plot Annotations for 'ggplot2'*. R package version 0.9.4. Retrieved from <https://www.R-project.org/>. (accessed 2019-05-08).