Middle School Students' Motivation in Learning Mathematics in Japan
日本の中学生の数学の学習動機について

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要旨

本稿では、日本の中学２年生の数学の学習の動機について Ryan と Deci(2000) の self-determination theory (自己決定理論)を本稿の枠組みとして、内的動機、外的動機に焦点を当てて、2011 年の国際数学理科教育動向調査(TIMSS)の日本の中学２年生 4414 名の数学に関するデータを利用して研究した。因子分析の結果、１つの内的動機と２つの外的動機が見られ、これをそれぞれ学習の楽しみ、教師の影響、有益的な価値と名付けた。これにより、生徒は数学の学習が楽しく、将来の目標に向けて数学が必要であると感じていることがわかった。また教員の教授法が、生徒が数学を学習する際にポジティブな影響を与えていることもわかった。また本研究の考察の結果は、枠組みとした理論とは一部異なるものであった。最後に、数学の教育実践においての今後の課題について言及した。

【キーワード】motivation, learning mathematics, middle schools, Japan, TIMSS.

1. Introduction

The importance of motivation in learning mathematics and the research in the area has received much attention in previous studies (e.g. Middleton & Spanias, 1999; Tahar, Ismail, Zamani, & Adnan, 2010; Zhang, Barkatsas, Law, Leu, Seah, & Wong, 2016; Zhu & Leung, 2010). Motivation is defined as how an individual is inspired to engage in a certain activity (Ryan & Deci, 2000). Motivation is important in learning math. Previous research stated that motivation is considered one of the important issues in mathematics education (Walker & Guzdial, 1999). Researchers need to increase their understanding of what students' motivation is and how it is regulated in order to comprehend their behaviors in math classrooms (Hannula, 2006).

Regarding motivational theories, as Zhu and Leung (2010) pointed out, there is no single theory or model that can explain different aspects of ones' motivation. Due to the complex nature of motivation, many motivational theories have been developed since the 1930s to elaborate different aspects of motivation (Zhu & Leung, 2010). Although researchers may not agree with the classifications of motivational aspects, they seem to have agreed on the two classifications of motivational types, which are intrinsic and extrinsic motivation (Zhu & Leung, 2010). Intrinsic motivation and extrinsic motivation were consistently found in extant studies (e.g. Hayamizu, 1997; Tahar et al., 2010; Teoh, et al., 2009; Zhu & Leung, 2010); however, previous studies inconsistently found different types of extrinsic motivation. For example, researchers have identified different types of extrinsic orientations. Examples of extrinsic motivation ranged from external pressure, self-ego, teacher influence, and the importance of math for present as well as future usage (e.g. Hayamizu, 1997; Tahar et al., 2010; Teoh, Koo, & Singh, 2009; Zhu & Leung, 2010; Yilmaz, et al., 2010). Among extrinsic motivations, the active form of extrinsic motivation is instrumental value or usefulness (e.g. Hayamizu, 1997; Tahar et al., 2010; Teoh et al., 2009; Zhu & Leung, 2010; Yilmaz, et al., 2010). An example of instrumental value was the importance of math in everyday life (Tahar et al., 2010). This suggests that students perceived math as an important subject to study because it was useful in daily life. Although this type of motivation is categorized as extrinsic, it also has some degree of intrinsic motivation.

Due to the inconsistent results for the types of extrinsic motivation in the literature, types of extrinsic motivation should be investigated further in addition to intrinsic motivation with nationwide data. The author in the present study used self-determination theory or SDT (e.g. Deci & Ryan, 2000) as a theoretical framework. SDT is representative of the self and is influential within motivational research (Zhu & Leung, 2010). The classifications of intrinsic and extrinsic motivation in the theory would be useful for understanding middle school students' motivation in learning math in Japan.

The purposes of the current study were to examine middle school students' motivational factors (i.e. intrinsic and extrinsic motivation) in learning math in Japan by applying SDT and identifying students' motivational factors.

2. Literature Review

2-1 Self-Determination Theory

Self-determination theory (SDT) assumes that an individual's propensity is to be curious and be interested in one's environment, learning, and development of one's knowledge. The theory states that when individuals have three basic psychological needs (competence, autonomy, and relatedness), they tend to internalize their motivation to learn and engage in their own studies (Niemiec & Ryan, 2009). Intrinsic and extrinsic motivation orientations are found within STD (e.g., Ryan & Deci, 2000). Individuals with intrinsic motivation simply enjoy doing a certain thing. Intrinsically motivated individuals often deeply engaged and persist in an activity for a long time (Wigfield & Cambria, 2010). Individuals with intrinsic motivation perform activities at their own will without any external reasons (Ryan & Deci, 2000). There is no doubt that intrinsic motivation is an important and desirable factor in education, however, it is not the only factor to be considered (Lepper & Henderlong, 2000). Extrinsic motivation is also frequently used in education. For example, individuals with extrinsic motivation do something because they perceive instrumental value, such as receiving a good grade (Ryan & Deci, 2000).

Extrinsic motivation involves different degrees of autonomy or self-determination and external control (Deci, Vallerand, Pelletier, & Ryan, 1991; Ryan & Deci, 2000; Vansteenkiste, Lens & Deci, 2006). Deci and his colleague (e.g., Ryan & Deci, 2000) claimed that there are four types of extrinsic motivation: external regulation, introjection, identification, and integration.

The first type and the least autonomous form of extrinsic motivation is external regulation. This form of motivation is well known as the classic definition of extrinsic motivation. Individuals are motivated to perform an activity by external rewards and punishments (Deci et al., 1991; Ryan & Deci, 2000; Vansteenkiste et al., 2006). For example, students attend classes regularly in order to avoid their instructors' warning. The second type of extrinsic motivation is introjection. Individuals perform a task to enhance or maintain their self-esteem and to avoid shame and guilt based on internal pressure (Deci et al., 1991; Ryan & Deci, 2000; Vansteenkiste et al., 2006). Some students are willing to answer an instructor's questions in class to show off their knowledge. The third type of extrinsic motivation, which is more autonomous than introjection, is identification and it is somewhat intrinsic. Persons have identified and accepted important values in a task and recognize the activity has instrumental value (Deci et al., 1991; Ryan & Deci 2000; Vansteenkiste et al., 2006). For example, students may take statistic classes due to an interest in learning the subject and the usefulness of knowledge for interpreting data. The last and most autonomous form of extrinsic motivation is integration. Persons have integrated an activity fully into their self and the activity is congruent with their values and needs. Even though this type of extrinsic motivation shares many intrinsic qualities, individuals are still externally motivated due to goals associated with groups (Deci et al., 1991; Ryan & Deci, 2000; Vansteenkiste et al., 2006). An example would be that students enjoy doing volunteer work with peers, who share the same goals. The last two types of extrinsic motivation have both external control and different degrees of autonomy. SDT does not categorize intrinsic versus extrinsic motivation as seen in earlier views of motivation but rather advocates the co-existence of intrinsic and extrinsic motivation.

3. Method

3-1 Participants, Materials, and Procedure

The author in the current study used the Japan TIMSS 2011 raw data in order to conduct a series of statistical analyses. The raw data was downloaded from TIMSS 2011 international database website. The data included randomly selected subjects of 4,414 eighth graders (2,231 males; 2,183 females) in 146 national, other public, and private middle schools. The usage of the TIMSS data is ideal since the sample size is adequate to conduct factor analysis and to investigate the theoretical framework. The

TIMSS 2011 Japan data sets had 1.3% missing values and the missing values were excluded from the analysis. The final number of the participants was 4,357 eighth graders.

National Institute for Educational Policy Research or NIER (2011) used two-stage stratified probability sampling techniques for selecting schools and individuals for assessing students' educational progress in TIMSS. They randomly selected a variety of schools from different regions of the country in the first stage and then randomly selected a few classes from these selected schools in the second stage. The International Association for the Evaluation of Educational Achievement (IEA) set 500 points as the mean math score with a standard deviation of 100 in the previous TIMSS scores. The TIMSS measured two domains of math abilities, which were cognitive domain (knowing, applying, and reasoning) and content domain (number, algebra, geometry, data, and chance) (NIER, 2011).

Students took Japanese translations of 80 test questions in math in 90 minutes. Each student had five plausible values in math due to the fact that students took different math tests from 14 different booklets. The IEA estimated participants' test scores to compare with their academic performance across countries (NIER, 2011). The questions consisted of multiple choices and fill-in-the-blanks. Participants filled in questionnaires about their demographic information, family background, school climate, and teacher effectiveness (NIER, 2011). Some of the student questionnaire responses were utilized for the purpose of this study.

3-2 Variables

Since TIMSS was not specifically designed to measure motivational factors related to math, the author initially examined all the motivational types of question items from students' preferences, confidence, value, and engagement in learning math. A total of 25 items were initially selected from the TIMSS data. These were students' preferences (5 items), confidence (9 items), value (6 items), and engagement (5 items). These were initially selected because they seemed to relate to motivation.

Then the author reduced the data into 11 questions as follows: 5 items for intrinsic motivation: engagement items 4 and 5, preferences items 1, 4, and 5. The author also selected 6 items for extrinsic motivation: value items 1, 2, 3, 4, 5, and 6. Examples of the questions were "I enjoy learning mathematics" (intrinsic motivation) and "I need math to get into a university" (extrinsic motivation). Students were asked how much they would agree with statements about math learning on a four-item Likert Scale from agree a lot (1) to disagree a lot (4). The author in this study chose the above items because they seemed to fit the definitions of SDT. For example, the intrinsic items were chosen based on the motivational definition that persons with intrinsic motivation perform activities at their own will without any external reasons (Ryan & Deci, 2000). The author chose the above extrinsic items based on the motivational definition that persons with extrinsic motivation perform something for external rewards (Ryan & Deci, 2000). Even though the author in this study selected the above items for the purposes of her study, these two dimensions are inseparable according to SDT. All the variables were re-coded in an ascending order from to disagree a lot (1) to agree a lot (4). The author used 11 motivational items (5 items for intrinsic and 6 items for extrinsic) for a series of factor analyses.

3-3 Data Analysis

The author in this study performed exploratory factor analysis because motivation is an underlying construct and TIMSS' motivation-related items were not made specifically based on intrinsic and extrinsic motivation theory. The purpose of factor analysis is to reproduce groups of correlations in the original data set by clustering subgroups of the observed motivational variables with a minimum number of factors (Heck, 1998). The author used principle axis factoring first because the primary purpose in the analysis was to extract a minimum number of factors that are necessary to reproduce the correlation matrix (Heck, 1998). The author conducted oblique rotation with maximum likelihood (ML) estimation next. ML estimation has several benefits and it is the recently preferred method for conducting factor analyses (Heck, 1998). Oblique rotation was chosen because it simplifies interpretation when factors are intercorrelated (Heck, 1998). The author assumed intrinsic and some types of extrinsic motivational factors (i.e. identified and integration regulation) to be correlated because some extrinsic types also had intrinsic motivation. Cronbach's alphas were also calculated to assess the internal consistency of each factor.

3-4 Proposed Model

Figure 1 Proposed Model of Japanese Students' Motivation

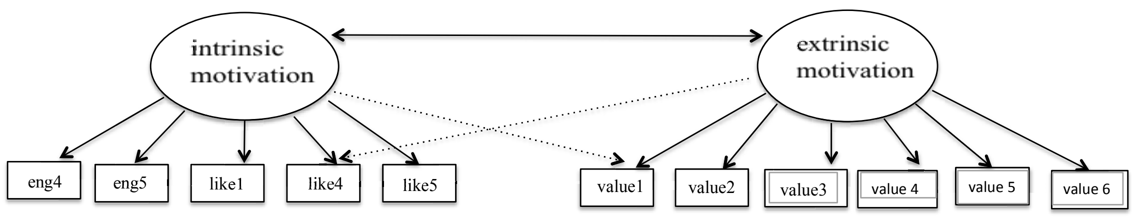

Figure 1 presents a proposed factor model of students' motivation in learning math in Japan. According to SDT (e.g., Ryan & Deci, 2000), the proposed model in the current study assumed to have two factors: intrinsic and extrinsic motivation. Variables engagement 4-5 and preferences 1, 4, and 5 were assumed to load on the intrinsic factor, whereas values 1-6 were assumed to load on the extrinsic factor. Double arrows pointing between factors indicate intercorrelation. Single arrows indicate the variables were loaded on each factor. Dotted lines indicated that the variables assumed to be loaded on the other motivational factor. The author assumed intrinsic and some types of extrinsic motivational factors to be correlated to each other due to their intrinsic nature.

4. Results

4-1 Preliminary Results

Table 1 Descriptive Statistics for the Motivational Items

	Mean	SD	Skewness	Kurtosis
I think math will help in daily life	2.13	.84	.43	-.34
I need math to learn other school stuff	2.26	.78	.33	-.2
I need math to get into university	2.07	.9	.51	-.5
I need math to get the job I want	2.24	.9	.21	-.77
I would like a job that involves using math	3.14	.8	-.75	.17
It is important to do well in math	1.75	.8	1.00	.71
I'm interested in what teacher says	2.57	.88	-.05	-.72
Teacher gives me interesting things to do	2.98	.77	-.43	-.13
I enjoy learning math	2.56	.92	-.05	-.81
I learn interesting things in math	2.71	.83	-.23	-.49
I like math	2.72	.96	-.27	-.86

*Note SD stands for standard deviation

As the readers can see, two questionnaire responses were particularly higher than the others. The higher means were about students' interests in getting a job using math (mean =3.14) and teachers' positive influence (mean = 2.98). On the other hand, the lower means were about the importance of doing well in math (mean = 1.75).

4-2 Primary Results

Table 2 Total Variance

Total Variance Explained by Factors						
		Initial Eigenvalues		Extract Sums of Squared Loadings		
Factor	Total	% of Variance	Cumulative Variance%	Total	% of Variance	Cumulative Variance%
1	3.59	44.91	44.91	3.21	40.15	40.15
2	1.53	19.16	64.01	1.20	14.93	55.08
3	1.00	12.47	76.54	0.73	9.14	64.23

After principle axis factoring analyses, the author eliminated a total of 3 items from the remaining 11 items because they did not meet minimum criteria of a factor loading of 0.4. The deleted items were value 1 (I think math will help in daily life.), value 2 (I need math to learn other school stuff.), and value 5 (I would like a job involving math). For the final stage, the author conducted principle axis factoring of the remaining 8 items in the final model. All the final questions are listed in the Appendix. The author initially ran a two-factor model; however, a three-factor model (i.e. one intrinsic and two extrinsic motivational factors) emerged as seen in Table 2. Table 2 presents the total variance explained by three motivational factors. Eigenvalues greater than one were selected. The three-factor solution accounted for 64% of the total variance. As shown in Table 2, three factors captured 40%, 15%, and 9% of the variance respectively.

Table 3 Factor Loadings with the Motivation-Related Scales

Scale	Enjoyment &Preference	Instrumental Value	Teacher Influence
I need math to get into university	-.06	**.87**	-.05
I need math to get into the job I want	-.03	**.78**	-.01
It's important to do well in math	.12	**.44**	.08
I'm interested in what teacher says	.02	.01	**.83**
Teacher gives me interesting things to do	-.01	.00	**.79**
I enjoy learning math	**.90**	-.02	-.01
I learn interesting things in math	**.68**	.03	.16
I like math	**.94**	.01	-.08

Note. Factor loadings > .40 are in boldface.

Table 3 shows the factor loadings from the final model. The first factor represented students' enjoyment and pleasure in learning math. The author named factor 1 enjoyment and preferences. In the enjoyment and preferences factor, the three items related to students' enjoyment in studying math and they were strongly loaded (from .68 to .94). Factor 2 indicated that instrumental value or usefulness, which means how a certain task fits into one's future plans (Wigfield & Cambria, 2010) as well as present plans. Factor 2 was named instrumental value. In the instrumental value factor, the three items were loaded moderately to strongly (from .44 to .87). Factor 3 was named teachers' influence. Factor 3 suggested that students were interested in math teachers' instructions. In the teachers' influence factor, the two items were loaded strongly (.79 and .83).

The result of goodness-of-fit was significant (.006), meaning that the final model was not adequate. However, a chi-square test was sensitive to sample size (Heck, 1998), the author kept the final model as the optimal model. Further, the reproduction correlations in Table 5 also indicate the appropriateness of the final model.

Table 4 Factor Correlation Matrix

Factor	Factor 1	Factor 2	Factor 3
Factor 1	1.0	.36	.56
Factor 2	.36	1.0	.33
Factor 3	.56	.33	1.0

Table 4 displays the results of factor correlation matrix. The factor correlation matrix showed that all factors overlapped each another. That is, factors 1 (enjoyment and preferences) and 3 (teacher influence) were overlapped at 32% of variance; likewise, factors 1 and 2 (instrumental value) overlapped at 13%, and factor 2 and 3 at 11%. As expected, all the factors were intercorrelated; hence, they were not completely distinct. The results indicated that all factors were not independent to each other, but they shared each other’s motivational characteristics. As for Cronbach’s alpha, all factors showed high internal consistencies as follows: .89 for enjoyment and preferences, .74 for instrumental value, and .79 for teacher influence.

Table 5 Reproduced Correlation Matrix

		Value 3	Eng 4	Eng 5	Value 4	Value 6	Like 1	Like 4	Like 5
Repro Cor	Value 3	.703a	.65	.41	.18	.16	.2	.21	.21
	Eng 4	.65	.596a	.38	.21	.18	.22	.23	.23
	Eng 5	.41	.38	.280a	.25	.22	.28	.28	.28
	Value 4	.18	.21	.25	.710a	.66	.43	.48	.39
	Value 6	.16	.18	.22	.66	.611a	.38	.43	.34
	Like 1	.2	.22	.28	.43	.38	.801a	.7	.8
	Like 4	.21	.23	.28	.48	.43	.7	.627a	.69
	Like 5	.21	.23	.28	.39	.34	.8	.69	.809a
Residualb	Value 3		.	.	.	.	.	-.01	.
	Eng 4	.		.	-.01	.	.	.01	.
	Eng 5	.	.		.01	-.01	.	.01	.
	Value 4	.	-.01	.01		.	.	-.01	.
	Value 6	.	.	-.01	.		-.01	.01	.
	Like 1	.	.	.	.	-.01		.	.
	Like 4	-.01	.01	.01	-.01	.01	.		.
	Like 5	.	.	.	.	.	.	.	

Note. a Reproduced communalities
b Residuals are computed between observed and reproduced correlations.
There are 0 (.0%) nonredundant residuals with absolute values greater than 0.05.

Table 5 shows the reproduced correlation matrix. The final factor model re-produced the original correlation matrix very well; Residuals were very small and no single residual was above 0.05. This evidence also suggests that the final three-factor model was necessary to adequately reproduce the correlations among the motivational variables (Heck, 1998).

4-3 Final Model

Figure 2. Final Model of Japanese Students' Motivation.

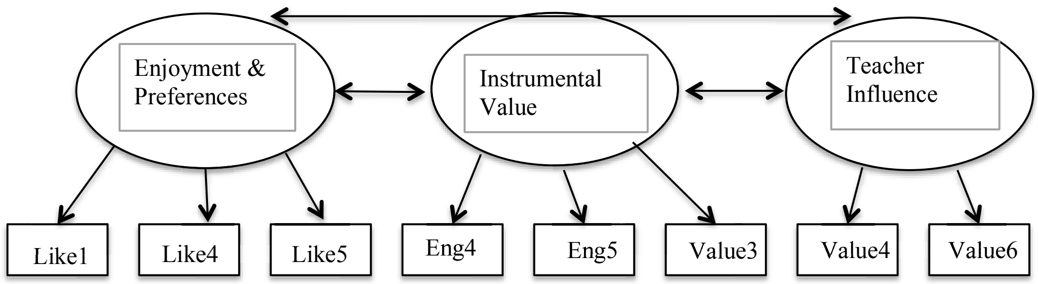

Figure 2 displays the final factor model of students' motivation in learning math in Japan. Three motivational factors were found: one intrinsic motivation and two types of extrinsic motivation. Students' preferences 1, 4, and 5 were loaded on intrinsic motivation. An example of an intrinsic item was the enjoyment of learning math. Engagement 4 and 5 were loaded on the first extrinsic motivation. An example of the first extrinsic item was the need for math to get into a university. Value 3, 4, and 6 were loaded on the last extrinsic motivational factor. An example of the item was students' interests in what the teacher said in class. The final model suggests that one intrinsic and two extrinsic motivational factors were intercorrelated to one another as seen in the double-sided arrows. Single-sided arrows indicate that motivational variables were loaded on each motivational factor.

5. Discussion

The author in the current study examined the selected motivation-related items from the TIMSS Japan data by using a series of exploratory factor analyses. The author found three factors (i.e. one intrinsic and two types of extrinsic factors) were related to one another in the present study. These three factors were teachers' influence (extrinsic), instrumental values (extrinsic), and enjoyment/preferences (intrinsic). These factors were all intertwined and not distinctively independent. More detailed discussions follow hereafter. Each subsection was created due to the results of Table 4.

5-1 Intrinsic Motivation

5-1-1 Enjoyment and Preferences

Intrinsic motivation is not the only form of motivation but is also essential, prevalent, and volitional

(Ryan & Deci, 2000). Students' enjoyment and preferences are well documented in the literature and the results of this study are in line with others (Hayamizu, 1997; Tahar et al., 2010; Teoh et al., 2009; Zhu & Leung, 2010). The results in the current study indicate that students tend to learn math because they like it rather than because math is beneficial. The results of descriptive statistics also matched the percentage of preferences of math at 65.9%, and enjoyment of studying math at 47.6%.

5-2 Extrinsic Motivation

The two extrinsic motivational factors found in the current study were more autonomous and somewhat intrinsic. This suggests that middle school students had extrinsic reasons but relatively higher self-determination to study math. Students with these types of extrinsic motivation have valued and internalized their external reasons. As a consequence, both instrumental value (e.g. I need math to get into university.) and teacher influence (e.g. A teacher gives me interesting things to do.) seemed to stimulate students in learning math. Ryan and Deci (2000) argued that understanding different types of extrinsic motivation and their roles are important for educators since they cannot always incorporate intrinsic motivation in the classroom. Ryan and Deci (2000) indicated that understanding and promoting useful and active types of extrinsic motivation becomes useful strategy for successful teaching. The results in the current study are also in line with other studies' (Hayamizu, 1997; Tahar et al., 2010; Teoh et al., 2009; Yilmaz et al., 2010; Zhu & Leung, 2010).

5-2-1 Instrumental Value

The result in the present study shows that Japanese students possessed instrumental values, such as the importance of math for present values as well as future values. Deci et al. (1999) stated that this type of motivation was still extrinsic motivation because students perform certain activities due to the usefulness of improving math skills and achieving future goals rather than due to the interests. Many students must have studied math hard because they recognized that it was important to do well in math in order to get into universities and get their desirable jobs. The finding of the current study matches others' studies (Hayamizu, 1987; Tahar et al., 2010, Zhu & Leung, 2010). For example, Hayamizu (1987) found that Japanese middle school students scored higher means in identified regulation than less autonomous motivation.

5-2-2 Teacher Influence

Teacher influence positively affected students' motivation in learning math in the current study. More specifically, the finding showed that students were interested in math teacher's instructions. What teachers said or did in math class seemed to have affected how students felt about studying math. The result in the present study is consistent with others' (Gilbert, Musu-Gillette, Woolley, Karabenick, Strutchens, & Martin, 2014; Yilmaz et al., 2010; Yu & Singh, 2016). Yilmaz et al. (2010) reported in their qualitative study that middle school students liked math when teaching instruction was good, whereas they disliked math when instruction was uninteresting. Yu and Singh (2016) also indicated that teachers' instructional practices had a positive influence on students' interests in math. Gilbert el al. (2010) also supported their results by reporting that teacher support directly influenced instrumental value.

5-3 Intrinsic and Extrinsic Motivation

Intrinsic and extrinsic motivational factors were related in the current study. The results in the present study revealed that the three motivational factors (i.e. enjoyment/ preferences, teacher influence, and instrumental value) were intertwined and overlapped. That is, these motivational factors had each other's characteristics. To be more specific, they were: a) enjoyment/preferences and teacher influence, b) enjoyment/preferences and instrumental values, and c) instrumental values and teacher influence. Detailed discussion of each result follows in the next section. Zhu and Leung (2010) stated that intrinsic and extrinsic motivation were influenced by many other factors and their interactions were a complex matter. In the current study both intrinsic and extrinsic motivational factors correlated moderately to relatively strongly and also both motivational constructs were overlapped. These findings can be explained in that intrinsic and extrinsic dimensions were coexistent rather than being polar opposites (Lepper & Henderlong, 2000; Lepper, & Iyengar, Henderlong, 2005). The results in the current study also revealed that extrinsic motivation has various types and some types could have different relationship with intrinsic motivation (Zhu & Leung, 2010).

5-3-1 Enjoyment/Preferences and Teacher Influence

Student enjoyment/preferences in learning math (intrinsic) and teacher influence (extrinsic) coexisted in this study. It was clear that math teacher positively influenced Japanese students' preferences toward math. This result was consistent with others' (Yilmaz et al., 2010). The current study's findings can be interpreted in a few different ways. First, the findings can be explained by the basic psychological need of relatedness in SDT. Niemiec and Ryan (2009) suggested that when individuals feel relatedness, autonomy, and competency, they tend to internalize their motivation to learn and engage in their own studies. That is, when Japanese students are related to what math teachers say or do in the classroom, they may be motivated to learn and engage in math intrinsically to some degree. Researchers suggested that teachers must teach students relevant math knowledge to facilitate students' development of intrinsic motivation. Students must understand that instructions are applicable and useful to other fields as well (Middleton & Spanias, 1999). Second, the finding in the current study may be interpreted from the perspective of the traditional educational system in Japan. In East Asia, the influence of Confucius values greatly affects the way teachers conduct classes. Examinations are a proper way to motivate students to learn and the pressure from extrinsic motivation is considered acceptable and healthy. Such extrinsic motivation gives incentives for students to learn (Leung, 2001). This suggests that Japanese students might have perceived teachers' extrinsic influence as stimulating their learning in math. Third, teachers' evaluations by their students may have forced teachers to teach more student-centered classes. As a consequence, Japanese students might have developed their preferences in math. As Leung (2001) wrote, when students enjoy learning, they can learn more effectively. Therefore teachers' instructions would naturally increase students' intrinsic motivation.

5-3-2 Enjoyment/Preferences and Instrumental Value

Japanese students reported both enjoyment/preferences (intrinsic) and instrumental value (extrinsic). Students' perception of utility value, such as the importance of math for future opportunities (i.e. going to college and job opportunities) and the present needs (i.e. the daily usages and the utility to learn other school subjects) influenced their preferences in math and vice versa. The result in the present study is in line with other studies' (Hayamizu, 1997; Tahar et al., 2010; Teoh et al., 2009; Yilmaz et al., 2010; Zhu & Leung, 2010). Since students sometimes have multiple reasons to study math, the result in the present study seem to be reasonable. The result in the current study may be interpreted that students' perception of importance of math tended to increase study hours and effort. These factors would increase students' understanding in the subject and that leads to pleasure in learning math.

5-3-3 Instrumental Value and Teacher Influence

Japanese students reported two extrinsic motivational factors (teacher influence and instrumental value) in learning math. This indicates that math teachers' pedagogical instructions were related to Japanese students' importance of math for future needs as well as present needs. A possible interpretation may be that teachers' emphasis of the importance and usefulness of math may lead students to think about how math could be useful for their immediate needs and future opportunities. This