Research paper

Japanese Pupils' Attribution of their Perceived Mathematics Performance and the Relationships Between their Attribution of Mathematics Performance and their Affective Attitudes Promoted by Different Teaching Methods

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Contextualisation

This paper explores the effects of 5th graders' (10-11 year-olds) and 8th graders' (13-14 year-olds) attribution of their perceived mathematics performance in relation to their affective attitudes towards mathematics learning promoted by different teaching methods adopted in mathematics classes. To achieve this, the paper addresses two sub questions using a questionnaire survey:

(1) What kinds of attribution do Japanese pupils tend to make for their perceived mathematics performance? Do pupils who perceive themselves as being good at mathematics and those who perceive themselves as being poor at mathematics make different attributions?
(2) How do Japanese pupils' attributions of their perceived mathematics performance affect their affective attitudes towards mathematics learning, promoted by the different teaching methods, adopted in their mathematics classes?

Abstract: *This research used a questionnaire survey to explore the relationship between pupils' attribution of their perceived mathematics performance and their affective attitudes towards mathematics learning as promoted by the different teaching methods they were exposed to in their mathematics classes. Both 5th and 8th graders attributed their success in learning mathematics to effort, although support from the teacher and support at home were also perceived as important factors in their success. The 5th graders and 8th graders overall gave effort-based attributions in the case of failure, while for 5th graders, ability was regarded as being as important as effort, in attributing failure in mathematics learning. Pupils who attributed their success in mathematics learning to effort, support at school and home, preferred teacher explanation and reading a textbook as learning strategies, while those attributing it to their ability preferred Individual work. Where pupils attributed success to luck, this seemed to have a negative effect on their affective attitudes towards mathematics learning as promoted by different teaching methods, while attributing failure to luck seemed to have positive effect. Attributing failure to poor teaching seemed to have a negative effect on their perception of teacher explanation. The relationships between pupil effort or ability based attributions of failure and their preference for different teaching methods were not clear. Adopting various teaching methods in mathematics classes would seem to support pupils who have different attribution styles.*

Introduction

Research on Japanese students' attribution styles

Japanese students have overall been reported to adopt an effort-based attribution style. This effort-based attribution is considered to come from their holding incremental theories of intelligence influenced by Confucian ideas (372-289 B.C.E). Children in Japan are considered to be born with equal virtues and intellectual abilities that they can develop themselves if their autonomous commitment towards learning is effectively supported by adults (Kojima, 1986).

The relationships between individuals' views of intelligence and their attribution style are found in the Dweck et al. surveys (1983; 1988). Students with an incremental perspective of intelligence build up effort-based attribution, while students with an entity perspective of intelligence do not do so when their confidence in their own intelligence is low.

Japanese students' effort-based attribution is also considered to come from how they view themselves. Japanese culture conceives of self as an interdependent state – a commitment to the individual role (role perfectionism) being based on individual effort, and exhortation (self-discipline) in the context of relationships with others (interpersonalism) (Kiefer, 1970; Marcus et al., 1991; Befu, 1986). Therefore, Japanese students' attributions are complicated: while effort is as internal factor it combines with external, situation-specific factors such as relationships with others, and these can work together in complicated ways to determine attributional style (Kashiwagi, 1986).

Age difference in attribution style has been reported in non-Japanese cultures in terms of its relations to attribution bias; which occurs in order to enable individuals to preserve their self-esteem. For instance, Skaalvik (1990) reported that Norwegian 9th graders who attributed their poor performance to lack of effort maintained high self-esteem, while 6th graders who attributed their poor performance to external causes had higher self-esteem than those attributing it to internal causes. Age difference in Japanese children's attribution style has not been surveyed. This study takes the age difference in attribution style as its starting point.

The effects of attributions on students' affective attitudes towards learning

Students' attribution of their perceived performance has been reported to affect their affective attitudes towards learning. Overall, students who ascribe success to ability rather than effort have been reported to be more motivated, while students who ascribe failure to lack of ability have been reported to be less motivated than when ascribing it to effort. Ascribing failure to lack of effort has been reported to have positive effects on pupils' motivation.

The negative effect of ascribing failure to lack of ability may be because students who ascribe failure to lack of ability cannot hope for future success. 'Learned helplessness' theory (Abramson et al., 1978) proposed that individuals who have a tendency to attribute their failure to stable factors tend to have lower outcome expectancy. Weiner (1986) suggests that ascribing negative outcomes to lack of effort provides individuals with expectancy for future success and enables lowered self-esteem to recover. Consequently, they can try harder in future. On the other hand, ascribing negative outcomes to lack of ability provides individuals with a low possibility of future success and hence decreased self-esteem from which it is less likely they will recover. As a result, the person feels submissive, inferior and helpless and loses their motivation to try.

The negative effect of attributing their failure to lack of ability is found among Japanese children. For instance, Nasu (1990) found that attributing failure in mathematics term examinations to lack of daily effort was positively related to feelings of regret, which led to positive learning behaviour and improvement of results in the next term's examination. In contrast, attribution of failure to a lack of ability was positively related to perceptions of incompetence, which led to negative learning behaviour and decreased performance in the next examination. Higuchi et al. (1986) found some Japanese 4th–6th graders attributed their failure to lack of luck and lack of ability rather than lack of effort and these children did not set up an appropriate level of goal attainment and perceived their level of success as low, although they had similar actual task achievement as pupils who had other attributional styles.

However, Covington's (1979) self-worth theory proposed that learners would attribute their failure to lack of effort in order to maintain a self-concept of high ability. Some studies with Japanese children reported such an effect of effort-based attribution in failure. For instance, Sakurai (1989) showed that Japanese 6th graders with higher levels of learned helplessness were less likely to attribute their success to ability and were more likely to attribute their failure to effort. Sugiura (1996)'s study supported this, with the findings that the attribution of failure to lack of effort was positively related to outcome expectancy for Japanese 5th-6th graders with a low level of learned helplessness, but not for those with a high level of learned helplessness who did not understand the meaning of making an effort. These findings suggest that effort-based attribution does not necessarily bring good results unless it contains high outcome expectancy for future tasks.

There are some studies which report the effects of the teaching methods on students' future success in the case of previous failure. Ito (1996) found that among the Japanese 7th graders that provision of the informational feedback and teaching about how to learn the subject (such as how to review, summarise and construct an answer) was reported as important for linking children's attribution of their failure to lack of effort and for encouraging them to hope for future success. The incremental theory dominant in Japanese culture encourages teachers to value informational feedback, because the Japanese believe that all children can succeed equally well if enough informational feedback is provided (e.g. Uttal, 1988). This paper explores the effects of the attribution style on students' affective attitudes promoted by the different teaching methods. This paper will make some recommendations concerning teaching strategies to be used with a range of students, based on the findings of this research.

Methods

A cross-sectional survey strategy was adopted using questionnaires. The sample consisted of 1479 5th graders (10-11 year-olds) belonging to 28 elementary schools, and 2156 of 8th graders (13-14 year-olds) belonging to 19 junior high schools in Tokyo. The chief reason for using the questionnaire method lies in its suitability for collecting a wide range of information from a large number of participants in a limited time to aim to improve the generalisability of findings, although superficiality of the data may be a shortcoming of using questionnaire in such a survey (Oppenheim, 1996). The researcher sent a letter of enquiry to the headteachers of all the state elementary and junior high schools located in four wards of Tokyo, and the private junior high schools located in Tokyo and its suburbs. The research was conducted, with all the schools, which expressed their willingness to take part in the survey. All the students in these schools, except those who were absent from school on the research day, took part in the questionnaire survey. Teachers and school staff who expressed their willingness to take part in the survey might have a greater interest in promoting pupils' affective attitudes towards learning mathematics, which might limit the generalisability of the findings.

Pupils' self-perceived mathematics performance

Pupils' perceived mathematics performance was assessed by asking them to what extent they perceived themselves as good or bad at mathematics, on a five point rating system: *very good, good, OK, poor,* and *very poor*. The question did not aim to assess the pupils' mathematics competence objectively. Rather, it aimed to obtain the pupils' subjective perceptions of their mathematics performance. Pupils' perceptions of their own competencies in mathematics are not necessarily reflected in visible achievements arising for example from the marks obtained in their mathematics tests, and it is the pupils' subjective perceptions of their mathematics performance that relate to their attitudes and affect (e.g. Bandura, 1997). This question was used as a filter for the question asking about pupils' attributions of their success or failure in mathematics learning.

Pupils' attribution of perceived mathematics performance

Table 1 lists the description for attributions used in the questionnaire sheet. The categories reflecting pupils' attributions employed in this study were ability, effort, luck, support from the mathematics teacher, support at home, and easy task. Weiner's (1986) achievement attributions, classified by locus, stability, and controllability dimensions, indicate that effort can be divided into two kinds, with long-term effort as a stable factor and temporary or situational effort for examinations as an unstable factor. Similarly, teachers' support can be divided into two kinds, with instructor bias/favouritism as a stable factor, and help from the teacher as an unstable factor. This study did not adopt this division. Weiner's (1986) model, mentioned above, includes health on the day of examination as an internal, unstable and uncontrollable factor. This study did not include this category, because the pupils' perceptions of their own competencies in mathematics were assumed not to be reflected by the results of a specific test, but rather by their longer-term feelings. Parental support and private educational opportunities have a strong positive influence on children's learning attitudes and mathematics performance (DfEE, 1992). Students not only discuss school with their parents but also seek help in doing homework from parents, older siblings and their *juku* teacher (Sawada, et al., 1986, Crystal et al., 1991). Therefore, support at home was included.

Assumed factor	Attributional category of pupils' success in learning mathematics	Attributional category of pupils' failure in learning mathematics
Ability	I am talented in learning mathematics.	I am not talented in learning mathematics.
Effort	I try hard to learn mathematics.	I do not try hard to learn mathematics.
Luck	It is just lucky if I do well at Maths classes.	It is just unlucky if I do not well at Maths classes.
Teacher	The instruction of our Maths teacher is very good.	*The instruction of our Maths teacher is not very good.*
Home Support	*I have enough support to do well from my parents or* juku *teachers.*	*I don't have enough support to do well from my parents or* juku *teachers.*
Easy Task	Tasks and tests are not so difficult in Maths classes.	Tasks and tests are very difficult in Maths classes.

Table 1: Statements indicating pupils' attributions of their perceptions of their own competencies in mathematics

Pupils' attributions of their perceived outcomes in learning mathematics were measured using a nominal (categorical) response system which requested participants to choose their own response(s) from a number of discrete categories (Oppenheim, 1996). A single-choice question was employed aiming to obtain a clear response as to how pupils attributed their mathematics performance. An 'other (please specify)' category was adopted for 8th graders, in order to avoid loss of rapport due to their feeling that the choice of answers failed to do justice to their own ideas (Oppenheim, 1996). 5th grade teachers taking part in the pilot study commented that such an additional response might confuse 5th graders. Therefore, the 'other (please specify)' category was not used in the questionnaire sheet for 5th graders.

A filter question, which excludes some respondents from a particular question sequence if those questions are irrelevant to them, was employed. The pupils who responded that they were very good, good or OK at mathematics were asked their views on why they thought they were successful in learning mathematics. Pupils who responded that they were poor or very poor at mathematics were asked for their views on why they thought that they were failing to learn mathematics.

Pupils' affective attitudes towards mathematics learning as promoted by different teaching methods

The Ministry of Education in Japan (1999) recommended the introduction of activity-based learning, effective choice of organisational strategies, provision of opportunities for peer-interaction and the practical use of computers in addition to those teaching methods traditionally adopted by teachers in Japan. These were to be introduced in 2002. The teaching methods considered in this study were selected in relation to those recommendations and through interviews with teachers in a pilot study. As a result, eight teaching methods were included: practical work, using computers, reading textbooks, teachers' explanation, individual work, individual help, whole-class discussion and group discussion. These methods are described in Table 2.

Descriptions	Definition of each teaching method
Practical work	Doing practical work in a small group, for example, making something together, doing experiments or investigation.
Using a computer	Using a computer.
Reading a textbook	Reading about something, for instance, explanations in textbooks.
Teacher explanation	Listening to the teacher explaining to the class, and the teacher asking the class questions.
Individual work	Doing individual work such as doing exercises.
Individual help	Individual help: talking to the teacher on your own about your work.
Whole-class discussion	Whole-class discussion where you give your ideas and you listen to others giving theirs.
Group discussion	Small-group discussion where you give your ideas and you listen to others giving theirs.

Table 2: Teaching methods included in this study

The second issue to be considered was the extent to which pupils were familiar with the words describing these teaching methods. Since the survey was conducted before the introduction of the reforms, not all teachers in mathematics classes were expected to be using all of these teaching methods. Pupils might therefore be unfamiliar with the words used to describe the teaching methods in the questionnaire. To solve this possible problem, examples of earlier survey research regarding teaching methods with children in the upper stage of elementary school were examined. In Japan, the National Institute for Educational Research (1990), which investigated 4th graders' preferences for 'whole-class learning sessions' or 'individual learning sessions' in mathematics classes, used these words, with explanations of what each kind of learning session was. Following this example, this study used explanatory sentences for the first appearance of each description, in order to promote pupils' understanding of what each teaching method involved. From the second appearance, these words were arranged in the corresponding order, to save the time and effort needed to read a long explanation each time, and also space on the questionnaire sheet. Confusion due to not understanding the words describing teaching methods was not found in the pilot study as evidenced by interview. Therefore, these descriptions were used in the main survey (see Table 2).

Pupils' perceptions of the frequency of use of different teaching methods and of the positive attitudes towards mathematics related to them were measured adopting closed questions with a five-point rating system. The question measuring the pupils' perceptions of the frequency of the use of teaching methods adopted five ratings: *always, nearly always, sometimes, hardly ever* and *never*. The questions measuring the pupils' attitudes towards learning mathematics in terms of teaching methods adopted five ratings: *absolute agreement, agreement, neither*

agreement nor disagreement, disagreement and *absolute disagreement*. One difficulty with ratings scales is that individual participant may interpret differently what each rating indicates, so objectivity may not be secure (Oppenheim, 1996). However, ratings are, in this case, used in a subjective way to indicate raters' perceptions (ibid.) of the frequency of the use of teaching methods and pupils' attitudes towards mathematics learning promoted by different teaching methods. Some researchers prefer to use an even number of steps, to avoid the tendency to choose the central option (ibid.). However, in the pilot study, some 5th graders found difficulty in responding to a scale with four steps as revealed by interview, which lacked the central option. Therefore, a five-point scale was adopted.

The study examined pupils' reported frequency of experiencing different teaching methods and their affective attitudes towards mathematics learning in relation to their enjoyment, motivation, sense of security and sense of progress. These features of pupils' attitudes towards learning were those Japanese children currently are perceived to lack as evidenced in international surveys (Japan, National Institute for Educational Research, 1997; 1998). The words employed to communicate these features on the questionnaire were chosen after discussion with many elementary and junior high school teachers during the pilot studies. The accessibility of the language was also checked in the pilot studies with the pupils.

The word 'enjoyment' is often used in Japan with reference to learning settings. For example, the Japanese National Institute for Educational Research (NIER)'s questionnaire survey of 4th graders in mathematics classes (1990), mentioned above, started with the question, 'Did you enjoy learning the topic 'area' in the individual session?' The word 'motivation' is a technical term in psychology. The NIER's (1990) study mentioned above used the words 'try hard to learn', when assessing an effort based view of children's motivation. The Japanese expression 'Ganbaru' (trying hard) was introduced into the international literature as the word expressing the Japanese educational ethos (e.g. Stevenson, 1992). The word translated here as 'sense of security' was taken from the sentence 'schools should be places where children feel relaxed and comfortable about concentrating on learning' in the recommendations of the Japan Curriculum Council (1998). This study adopted this explanation to express 'sense of security'. Attempts were made to select words which communicated to the pupils that 'having a sense of progress' is a term focusing on their feelings about progress rather than actual progress. Repeated discussion with teachers and the results of the pilot studies confirmed the high probability of success in communicating the researcher's intentions to the pupil participants. The questions employed in the questionnaire for pupil participants were as follows.

- How often do you have these kinds of learning methods in your mathematics lessons?
- Do these methods help you to enjoy learning mathematics?
- Do these methods encourage you to try hard in mathematics?
- Do you feel relaxed in learning mathematics by using these particular methods?
- Do you think these methods help you to feel that you are making progress in learning mathematics?

Data analysis

Attributions of success

Approximately one third of pupils of both age groups attributed their success in mathematics learning to effort. 5th graders were more likely to attribute their success to support from others such as home support or support from the teacher in mathematics classes than 8th graders, while 8th graders were more likely to attribute their success in mathematics learning to luck than 5th graders. Few from each grade attributed their success in mathematics learning to ability or easiness of the task provided. Few 8th graders (5.2% as shown in 7=Others in Table 3) expressed attributions of their success in learning mathematics in their own words. Of those that did, the attributions were 'I am interested in maths' (N=42, 3.7%), 'I learned maths a lot in my early years' (N=7, 0.6%), and the 'Learning materials are good for promoting my understanding' (N=1, 0.1%).

	1=Ability	2=Effort	3=Luck	4=Teacher Support	5=Home Support	6=Easy Task	7=Others
5th graders	31 (2.7%)	364 (31.0%)	92 (7.9%)	269 (23.0%)	381 (32.4%)	35 (3.1%)	----------
8th graders	58 (5.1%)	411 (36.3%)	158 (13.9%)	193 (17.0%)	208 (18.4%)	47 (4.1%)	59 (5.2%)

Table 3: Percentage of pupils attributing being good or average at mathematics to the following factors

Attribution of failure

5th and 8th graders who reported themselves as poor or very poor at mathematics were asked to choose one possible reason for failure from six alternatives: lack of ability, lack of effort, lack of luck, lack of teacher support, lack of home support and task difficulty. A space was left for 8th graders to write an alternative reason for being poor at mathematics. The majority of 8th graders attributed their being poor at mathematics to lack of effort. Effort-based attribution in failure was found more at 8th grade than 5th grade. 5th graders were more likely to attribute their being poor at mathematics to lack of ability. Effort-based attributions of 8th graders and ability-based attributions of 5th graders manifested among the pupils perceiving themselves poor at mathematics were greater than those for pupils perceiving themselves good or average at mathematics. Slightly more than one tenth of 5th graders attributed their being poor at mathematics to task difficulty. Fewer 8th graders gave task-based attributions. Pupils from both age groups attributing their being poor at mathematics to lack of luck, lack of teacher support or lack of home support were very few. Approximately one tenth of 8th graders (10.4% as shown in 7=Others in Table 4) described their attribution of failure in their own words. Those attributions were 'I am not interested in mathematics' (3.3%), 'I often make tiny mistakes' (2.7%), 'I can't develop my understanding' (1.1%), 'I don't know how to learn mathematics effectively' (0.6%) and 'others' (2.7%).

	Lack of Ability	Lack of Effort	Lack of Luck	Lack of Teacher Support	Lack of Home Support	Task Difficulty	Others
5th graders	88 (35.9%)	97 (39.6%)	9 (3.7%)	7 (2.9%)	10 (4.1%)	34 (13.9%)	----------
8th graders	88 (10.8%)	487 (59.8%)	16 (2.0%)	55 (6.8%)	24 (2.9%)	58 (7.1%)	86 (10.4%)

Table 4: Percentage of pupils attributing their poor at mathematics to the following factors

The effects of attribution of success on their preferred teaching methods

(a) Responses of 5th graders perceiving themselves successful in mathematics learning

The most notable finding was that there were some differences in preference for particular teaching methods between 5th graders attributing success to effort or support from the teacher and at home and those attributing it to ability or task easiness. 5th graders who attributed success to support from the teacher, followed by effort and home support were more likely to think that ***teacher explanation*** could promote their enjoyment, motivation, sense of security and sense of progress than were those attributing success to ability. In contrast, 5th graders who attributed success to ability or task easiness thought more often, than those attributing it to support from the teacher that ***individual work*** could promote the four aspects of affective attitudes and that this method was deployed more frequently (see Table 5).

Teacher explanation	Enjoyment			Motivation			Sense of security			Sense of progress			Deployment		
	N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD
Ability	32	2.72	1.44	32	2.72	1.33	32	2.81	1.28	32	3.53	1.41	31	3.77	.88
Effort	**363**	**3.49**	**1.17**	**364**	**3.40**	**1.18**	**362**	**3.47**	**1.17**	**364**	**3.91**	**1.07**	361	3.78	.95
Luck	93	2.98	1.15	93	2.53	1.14	93	2.68	1.27	93	3.35	1.21	93	3.58	.96
Teacher support	**270**	**3.75**	**1.08**	**270**	**3.79**	**1.11**	**270**	**3.81**	**1.07**	**269**	**4.28**	**.85**	267	3.85	.92
Home support	381	3.47	1.19	381	3.38	1.21	379	3.44	1.24	379	3.90	1.14	379	3.61	1.02
Task easiness	36	3.11	1.30	36	3.00	1.33	36	3.14	1.42	36	3.64	1.38	36	3.75	1.08
ANOVA	F=9.799, p<. 01			F=18.896, p<. 01			F=15.153, p<. 01			F=12.180, p<. 01			F=2.661, p<. 05		

Individual Work	Enjoyment			Motivation			Sense of security			Sense of progress			Deployment		
	N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD
Ability	**32**	**3.50**	**1.55**	**32**	**3.78**	**1.36**	**32**	**4.00**	**1.37**	**32**	**3.94**	**1.24**	**31**	**3.90**	**1.11**
Effort	364	3.01	1.20	364	3.22	1.31	362	3.42	1.30	364	3.68	1.20	360	3.66	.92
Luck	93	2.59	1.17	93	2.83	1.32	93	2.89	1.36	93	3.33	1.30	93	3.31	.97
Teacher support	270	2.84	1.24	270	2.94	1.37	270	3.01	1.30	269	3.38	1.26	267	3.47	.93
Home support	381	3.11	1.37	381	3.21	1.42	379	3.44	1.33	379	3.65	1.31	378	3.66	.89
Task easiness	**36**	**3.42**	**1.52**	**36**	**3.47**	**1.46**	**36**	**3.75**	**1.34**	36	3.67	1.39	**36**	**3.81**	**.98**
ANOVA	F=5.041, p<. 01			F=4.398, p<. 01			F=8.332, p<. 01			F=3.335, p<. 01			F=4.486, p<. 01		

Table 5: Mean scores and Standard Deviation of 5th graders' perceived deployment of *Teacher explanation* and *Individual work* and their affective attitudes towards mathematics learning promoted by these teaching methods according to their attribution styles of success in mathematics learning

A similar pattern emerged in the relationship between the attributions of 5th graders and their sense of security as promoted by ***individual help***, although those attributing their success to support from the teacher perceived more frequent use of ***individual help*** than did those attributing it to ability and task easiness. 5th graders attributing their success to effort or support from others were likely to prefer an interactive learning style, while those attributing it to ability or task easiness were more likely to prefer an independent learning style (see Table 6).

Individual Help	Enjoyment			Motivation			Sense of security			Sense of progress			Deployment		
	N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD
Ability	31	2.23	1.33	32	2.88	1.54	**32**	**3.22**	**1.39**	32	3.28	1.63	31	2.23	.96
Effort	362	2.55	1.16	364	2.80	1.30	362	2.95	1.30	364	3.40	1.26	364	2.88	1.01
Luck	93	2.25	1.13	93	2.31	1.17	93	2.33	1.22	93	3.08	1.28	92	2.64	1.01
Teacher support	270	2.40	1.23	270	2.56	1.28	270	2.77	1.26	269	3.22	1.35	**268**	**3.02**	**.89**
Home support	379	2.50	1.26	380	2.73	1.38	379	2.87	1.41	379	3.43	1.38	380	2.74	1.02
Task easiness	35	2.77	1.54	35	2.83	1.60	35	2.97	1.52	36	3.03	1.56	36	2.42	1.18
ANOVA	F=1.842, p<. 5			F=2.831, p<. 05			F=3.985, p<. 01			F=2.011, p<. 1			F=6.983, p<. 01		

Table 6: Mean scores and Standard Deviation of 5th graders' perceived deployment of *Individual help* and their affective attitudes towards mathematics learning promoted by this teaching method according to their attribution styles of success in mathematics learning

This is also the case for learning mathematics through discussion. Discussion, which involves interaction, was more likely to be preferred by those attributing success to support from teachers and effort, than by those attributing it to ability and task easiness. 5th graders attributing success to support from teachers and effort perceived more than those attributing it to ability and task easiness that motivation and sense of progress were promoted by ***whole-class discussion***. The same pattern was found in sense of security promoted by ***group discussion*** and perceived frequency of this teaching method (see Table 7).

Whole-class discussion	Enjoyment			Motivation			Sense of security			Sense of progress			Deployment		
	N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD
Ability	32	2.94	1.24	32	2.78	1.36	32	2.91	1.33	32	3.41	1.39	31	3.13	1.09
Effort	364	3.36	1.10	**364**	**3.35**	**1.14**	362	3.33	1.15	**364**	**3.60**	**1.14**	359	3.42	1.05
Luck	93	2.94	1.17	93	2.96	1.24	93	2.90	1.22	93	3.17	1.30	91	3.21	1.26
Support form teacher	270	3.31	1.21	**270**	**3.37**	**1.20**	270	3.30	1.22	**269**	**3.58**	**1.21**	267	3.45	1.00
Home support	381	3.20	1.20	381	3.18	1.21	379	3.18	1.25	379	3.34	1.24	376	3.31	1.08
Task easiness	36	3.17	1.11	36	2.94	1.37	36	3.08	1.38	36	3.19	1.41	36	2.92	1.18
ANOVA	F=2.814, p=. 02			F=3.807, p=. 002			F=2.722, p=. 02			F=3.603, p=. 003			F=2.648, p=. 02		

Group discussion	Enjoyment			Motivation			Sense of security			Sense of progress			Deployment		
	N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD
Ability	32	3.16	1.19	32	2.91	1.28	32	3.03	1.28	32	3.44	1.37	30	2.33	.99
Effort	364	3.33	1.18	364	3.32	1.12	**362**	**3.36**	**1.15**	364	3.39	1.12	**362**	**2.51**	**.89**
Luck	93	3.08	1.18	93	2.98	1.15	93	2.86	1.24	93	3.13	1.15	93	2.38	.91
Support form teacher	270	3.29	1.18	270	3.26	1.22	**270**	**3.31**	**1.19**	268	3.48	1.17	**267**	**2.58**	**1.01**
Home support	381	3.08	1.17	381	3.15	1.19	379	3.18	1.19	378	3.21	1.21	378	2.39	.90
Task easiness	36	3.11	1.17	36	2.78	1.31	36	2.97	1.28	36	3.06	1.45	36	2.03	.77
ANOVA	F=2.28, p=. 05			F=2.97, p=. 01			F=3.638, p=. 003			F=2.74, p=. 02			F=3.454, p=. 004		

Table 7: Mean scores and Standard Deviation of 5th graders' perceived deployment of *Whole-class discussion* and *Group discussion* and their affective attitudes towards mathematics learning promoted by this teaching method according to their attribution styles of success in mathematics learning

5th graders attributing their success to task easiness perceived more that ***practical work*** could promote their sense of security and sense of progress, while those attributing success to support at home perceived less that this teaching method could promote these aspects. 5th graders attributing their success to task easiness perceived that this teaching method was less frequently deployed in mathematics classes than did the students who had other attributional

style of this teaching method. In spite of that, those pupils felt secure in learning mathematics by this method. 5th graders attributing their success to support from the teacher perceived more frequent deployment of this teaching method than did those attributing their success to task easiness (see Table 8).

Practical work	Enjoyment			Motivation			Sense of security			Sense of progress			Deployment		
	N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD
Ability	32	3.47	1.24	32	3.28	1.44	32	3.63	1.34	32	3.56	1.46	31	2.23	.99
Effort	364	3.46	1.25	364	3.50	1.26	361	3.43	1.19	363	3.62	1.20	364	2.45	.87
Luck	93	3.08	1.34	93	3.13	1.32	93	2.78	1.24	93	3.19	1.26	93	2.40	.86
Support form teacher	270	3.49	1.27	270	3.40	1.29	270	3.31	1.19	269	3.59	1.24	**268**	**2.60**	**1.00**
Home support	381	3.27	1.31	381	3.28	1.30	**379**	**3.24**	**1.31**	**378**	**3.35**	**1.31**	381	2.42	.86
Task easiness	36	3.56	1.56	36	3.42	1.52	**36**	**3.61**	**1.38**	**36**	**3.67**	**1.33**	**36**	**1.83**	**.94**
ANOVA	F=2.397, p=. 04			F=1.746, p=. 12			F=5.014, p=. 000			F=3.18, p=. 007			F=5.390, p=. 000		

Table 8: Mean scores and Standard Deviation of 5th graders' perceived deployment of *Practical work* and their affective attitudes towards mathematics learning promoted by this teaching method according to their attribution styles of success in mathematics learning

As mentioned above, pupils attributing success to support at home perceived less that ***practical work*** could promote their sense of security and sense of progress, 5th graders attributing their success to effort or support at home perceived more than those attributing it to task easiness that ***reading a textbook*** could promote their enjoyment and motivation. This may reflect that learning mathematics by ***reading a textbook*** is more likely to be supported at home than learning mathematics by ***practical work*** (see Table 9).

Reading a textbook	Enjoyment			Motivation			Sense of security			Sense of progress			Deployment		
	N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD
Ability	32	2.88	1.24	32	2.66	1.29	32	2.78	1.16	32	3.44	1.34	31	3.52	1.12
Effort	**364**	**3.05**	**1.14**	**363**	**3.03**	**1.22**	362	3.19	1.25	364	3.69	1.21	362	3.58	.91
Luck	93	2.61	1.16	93	2.58	1.18	93	2.81	1.26	93	3.24	1.43	93	3.44	1.04
Teacher support	270	2.76	1.14	270	2.63	1.21	270	2.99	1.27	268	3.49	1.24	267	3.42	.94
Home support	**379**	**2.90**	**1.14**	**380**	**2.83**	**1.28**	378	2.96	1.38	378	3.45	1.38	381	3.43	.95
Task easiness	36	2.53	1.28	36	2.53	1.38	36	3.25	1.23	36	3.58	1.36	36	3.22	1.31
ANOVA	F=3.811, p=. 002			F=4.523, p=. 000			F=2.392, p=. 04			F=2.421, p=. 03			F=1.78, p=. 11		

Table 9: Mean scores and Standard Deviation of 5th graders' perceived deployment of *Reading a textbook* and their affective attitudes towards mathematics learning promoted by this teaching method according to their attribution styles of success in mathematics learning

5th graders attributing success to luck overall perceived less that all teaching methods could promote positive affective attitudes towards mathematics learning.

(b) Responses of 8th graders perceiving themselves successful in mathematics learning

The relationships between pupils' attributional style and their preferred teaching method were found among the responses of 8th graders as well. 8th graders attributing success to effort and support from the teacher perceived more than those attributing success to ability that ***teacher explanation*** and ***reading a textbook*** could promote positive affective attitudes. Support for learning mathematics by ***reading a textbook*** seemed to move from home to school as pupils' grades proceeded. 8th graders attributing success to ability, effort or task easiness perceived more than those attributing it to support from the teacher that ***individual work*** could promote their sense of security and sense of progress. Thus, those attributing their success to effort

perceived that all of these teaching methods could promote their affective attitudes. 8th graders attributing success to luck overall perceived less that all teaching methods could promote positive affective attitudes towards mathematics learning (see Table 10).

Teacher explanation	Enjoyment			Motivation			Sense of security			Sense of progress			Deployment		
	N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD
Ability	58	2.86	1.33	58	2.72	1.25	58	3.21	1.39	58	3.69	1.20	57	4.04	1.02
Effort	**412**	**3.58**	**1.15**	**412**	**3.48**	**1.13**	**409**	**3.71**	**1.11**	**408**	**4.08**	**.97**	409	4.22	.84
Luck	160	3.23	1.25	160	3.09	1.22	160	3.18	1.23	158	3.62	1.13	157	3.81	1.06
Teacher support	**196**	**3.86**	**1.07**	**196**	**3.71**	**1.01**	**194**	**3.91**	**.98**	**196**	**4.19**	**.89**	192	4.17	.87
Home support	209	3.28	1.17	208	3.08	1.18	208	3.37	1.20	209	3.74	1.06	207	4.06	.96
Task easiness	49	3.22	1.34	49	2.86	1.15	49	3.29	1.41	49	3.86	1.06	49	4.27	1.00
ANOVA	F=6.52, p<. 01			F=14.185, p<. 01			F=11.278, p<. 01			F=9.459, p<. 01			F=5.151, p<. 01		

Reading a Textbook	Enjoyment			Motivation			Sense of security			Sense of progress			Deployment		
	N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD
Ability	58	2.41	1.31	58	2.34	1.24	58	2.88	1.35	58	3.21	1.40	56	2.93	1.22
Effort	**412**	**2.74**	**1.19**	**410**	**2.65**	**1.21**	**409**	**3.02**	**1.24**	**409**	**3.31**	**1.24**	408	3.21	1.15
Luck	159	2.41	1.08	159	2.24	1.13	160	2.56	1.17	158	2.89	1.16	157	2.98	1.15
Teacher support	**196**	**2.66**	**1.11**	**196**	**2.64**	**1.13**	**194**	**2.99**	**1.17**	**196**	**3.29**	**1.20**	193	3.16	1.17
Home support	209	2.66	1.17	207	2.49	1.17	208	2.79	1.23	209	3.13	1.12	209	3.17	1.22
Task easiness	49	2.37	1.25	49	2.06	.97	49	2.63	1.33	49	2.76	1.25	47	2.74	1.34
ANOVA	F=2.645, p<. 01			F=4.986, p<. 01			F=4.217, p<. 01			F=4.461, p<. 01			F=1.574, p<. 50		

Individual work	Enjoyment			Motivation			Sense of security			Sense of progress			Deployment		
	N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD
Ability	58	3.16	1.35	58	3.64	1.24	**58**	**4.03**	**1.20**	**58**	**3.97**	**1.06**	57	3.88	.96
Effort	412	3.53	1.21	412	3.66	1.23	**409**	**3.95**	**1.17**	**409**	**4.10**	**1.02**	409	4.05	.79
Luck	160	3.25	1.17	160	3.41	1.23	160	3.49	1.28	158	3.72	1.11	159	3.76	1.02
Teacher support	196	3.29	1.23	196	3.40	1.22	194	3.58	1.09	196	3.78	1.09	193	3.84	.84
Home support	209	3.28	1.18	208	3.53	1.17	208	3.72	1.12	209	3.89	1.06	208	3.94	.82
Task easiness	49	3.29	1.34	49	3.31	1.25	**49**	**3.82**	**1.30**	**49**	**3.94**	**1.13**	49	3.86	1.12
ANOVA	F=1.943, p<. 05			F=2.284, p<. 05			F=5.484, p<. 01			F=4.242, p<. 01			F=3.236, p<. 01		

Table 10: Mean scores and Standard Deviation of 8th graders' perceived deployment of *Teacher explanation*, *Reading a textbook*, and Individual work and their affective attitudes towards mathematics learning promoted by this teaching method according to their attribution styles of success in mathematics learning

The effects of attribution of failure on pupils' preferred teaching methods

(c) Responses of 5th graders perceiving themselves as failing in mathematics learning

5th graders' affective attitudes towards mathematics learning as promoted by different teaching method, overall, did not vary according to their attribution of failure in mathematics learning. 5th graders attributing their failure in mathematics learning to lack of teacher support perceived that ***teacher explanation*** could promote positive affective attitudes towards mathematics learning less, although the number of 5th graders attributing their failure to lack of support from the teacher was few. In contrast, 5th graders attributing their failure in mathematics learning to lack of effort, task difficulty or lack of luck perceived ***teacher explanation*** more positively. 5th

graders' perceptions of the frequency of deployment of each teaching method did not vary according to the way they attributed their failure (see Table 11).

Teacher explanation	Enjoyment			Motivation			Sense of security			Sense of progress			Deployment		
	N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD
Lack of ability	88	2.93	1.28	88	2.77	1.32	88	2.75	1.38	88	3.08	1.44	87	2.93	1.19
Lack of effort	97	3.53	1.25	97	3.08	1.33	97	3.23	1.34	97	3.45	1.38	97	3.19	1.25
Lack of luck	9	3.33	1.80	9	3.11	1.76	9	3.67	1.66	9	4.11	1.36	9	4.11	.93
Lack of teacher support	**7**	**1.43**	**1.13**	**7**	**1.14**	**.38**	**7**	**1.29**	**.76**	**7**	**1.29**	**.76**	7	2.14	1.07
Lack of home support	10	2.50	1.51	10	2.50	1.18	10	2.30	1.42	10	2.80	1.32	10	3.40	1.27
Task difficulty	34	3.38	1.28	34	3.38	1.44	34	3.26	1.38	34	3.68	1.41	34	3.00	1.02
ANOVA	F= 5.317, p<. 01			F=4.016, p<. 01			F=4.535, p<. 01			F=4.984, p<. 01			F=2.842, p<. 05		

Table 11: Mean scores and Standard Deviation of 5th graders' perceived deployment of *Teacher explanation* and their affective attitudes towards mathematics learning promoted by this teaching method according to their attribution styles of failure in mathematics learning

(d) Responses of 8th graders perceiving themselves as failing in mathematics learning

8th graders attributing their failure in mathematics learning to lack of teacher support perceived that ***teacher explanation*** promoted their motivation and sense of progress less, while those attributing their failure in mathematics learning to lack of luck, lack of effort and task difficulty perceived more that these teaching methods promoted these aspects positively. These was a similar pattern in the findings relating to 5th graders. 8th graders attributing their failure in mathematics learning to lack of teacher support also perceived that ***group discussion*** promoted their sense of progress less than those attributing it to other factors. 8th graders' perceptions of the frequency of deployment of each teaching method did not vary according to the way they attributed their failure (see Table 12).

Teacher explanation	Enjoyment			Motivation			Sense of security			Sense of progress			Deployment		
	N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD
Lack of ability	88	3.22	1.32	87	2.71	1.37	87	3.05	1.39	87	3.60	1.26	87	3.85	1.17
Lack of effort	487	3.35	1.22	**485**	**3.22**	**1.21**	482	3.41	1.20	**482**	**3.82**	**1.06**	485	3.93	1.05
Lack of luck	16	3.50	1.21	**16**	**3.56**	**1.26**	16	3.44	1.03	**16**	**4.00**	**1.16**	16	3.69	1.20
Lack of teacher support	55	2.65	1.42	**54**	**2.48**	**1.30**	55	2.93	1.41	**55**	**3.07**	**1.29**	55	3.73	1.06
Lack of home support	24	3.38	1.31	24	3.17	1.37	24	3.38	1.31	24	3.71	1.08	24	3.96	.96
Task difficulty	58	3.21	1.28	**58**	**3.28**	**1.25**	58	3.36	1.29	**58**	**3.93**	**1.01**	58	3.64	1.12
ANOVA	F=1.512, p<1.0			F=2.293, p<. 01			F=1.257, p<1.0			F=2.470, p<. 01			F=1.277, p<. 5		

Group discussion	Enjoyment			Motivation			Sense of security			Sense of progress			Deployment		
	N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD
Lack of ability	88	2.72	1.39	87	2.83	1.46	87	2.67	1.44	87	2.53	1.27	87	1.51	.79
Lack of effort	487	2.72	1.29	484	2.69	1.24	480	2.60	1.21	482	2.72	1.19	482	1.56	.75
Lack of luck	16	2.63	1.26	16	2.44	1.41	16	2.25	1.13	16	2.50	1.16	16	1.44	.73
Lack of teacher support	55	2.55	1.39	55	2.55	1.36	55	2.31	1.25	**55**	**2.11**	**1.29**	55	1.35	.70
Lack of home support	24	3.08	1.35	24	2.71	1.20	24	2.88	1.19	24	2.79	.98	23	1.70	.64
Task difficulty	58	2.67	1.47	58	2.71	1.21	58	2.53	1.05	58	2.48	1.06	58	1.47	.68
ANOVA	F=1.092, p<. 5			F=. 775, p<1.0			F=1.327, p<. 5			F=2.039, p<. 01			F=1.297, p<. 5		

Table 12: Mean scores and Standard Deviation of 8th graders' affective attitudes promoted by *Teacher explanation* according to their attribution styles of failure in mathematics learning

Discussion

Differences were found in 5th and 8th graders' attribution, especially, those of failing to learn mathematics, although exploring pupils' attribution of their perceived mathematics performance using a forced choice question may over simplify the issue. Some 5th graders attributed their failure in mathematics learning to lack of ability. The literature suggests that there are negative effects arising from an attribution of failure to lack of ability. This affects learners' self-esteem and academic concept (Weiner, 1986; Harnisch et al., 1983; Higuchi et al., 1986; Masuda, 1994; Ito, 1996). Some of the younger children might not have developed a self-serving system of attribution although some of the children clearly had (Pintrich, 1996; Skaalvik, 1990). Teachers therefore need to support young pupils to build effort-based attributions.

Teachers, however, should be aware that assessing pupils' effort through their attainments could be unproductive. Mastery learning, which implies that all pupils can achieve certain levels, is accepted in Japanese schools, especially elementary schools (deVito et al., 1989). It aims for equality of outcome (Foster et al., 1996). This may put some children under enormous pressure and lead to ability-based attribution in failure. Some children may require additional support to give them confidence, and progress, however slow, should be positively evaluated.

Eighth graders gave effort-based attributions for both success and failure in mathematics learning. This autonomy should be developed even in pupils who perceive themselves as failing at mathematics. Although this study did not show the clear effects of pupils' effort-attribution style in failure on their affective attitudes as promoted by the teaching methods used, the earlier literature has suggested that Japanese children with higher levels of helplessness tend to attribute their failure to effort but do not have outcome expectancy for future tasks (Sakurai, 1989; Sugiura, 1996; Ito, 1996). Teachers need to enable all pupils to experience a sense of progress in order to make the need for effort meaningful.

Pupils' attribution styles affected the frequency with which they perceived the deployment of different teaching methods and their perceptions of the extent to which their affective attitudes were promoted by these teaching methods. In short, pupils' attribution of success to effort, support at school and home, which was the most prevailing attribution style, was positively related to their preference for ***teacher explanation*** and ***reading a textbook*** at both grades and to ***whole-class discussion*** and ***group discussion*** at 5th grade. Pupils attributing their success to support from the teacher disliked ***individual work***. In contrast, pupils attributing

their success to ability and task easiness favoured ***individual work***, and disfavoured ***teacher explanation*** and ***reading a textbook*** at both grades.

5th graders attributing success to task easiness favoured ***practical work*** and ***individual work*** and ***help***, although they perceived less frequent deployment of these teaching methods than those who had other attribution styles. 5th graders attributing their success to help at home preferred ***reading a textbook***, but disliked ***practical work***. Given that many 5th graders attributed their success to help at home, the way learning mathematics at school and at home needs to be considered at 5th grade.

Those pupils attributing success to luck perceived less frequent deployment of all of the teaching methods and less positive affective attitudes promoted by them than did those pupils who had other attribution styles. In contrast, pupils' attribution of failure to luck did not cause negative effects compared with other attribution styles. This supports Weiner's (1986) theory that ascribing positive outcomes to external causes affects academic concepts negatively, but ascribing negative outcomes to external causes does not affect pupils' academic concepts. Overall, pupils' attribution style in relation to failure did not have such strong effects as their attribution style for success on their perceptions of teaching methods. However, pupils attributing failure to lack of teacher support did not value the effects of ***teacher explanation*** on promoting positive affective attitudes. For pupils who are not satisfied with their teacher's support, a method dominated by the teacher's input may not be well received or trusted.

Given that there may be pupils who have different attribution styles in mathematics classes and that their attribution styles are linked with their preference of teaching methods, adoption of a broad range of methods is important to satisfy individual differences. The literature already suggests that teachers believe that the adoption of a broad range of methods is beneficial to satisfy differences in pupils' needs arising from differences in attainment (e.g. Ishida et al., 1986; Kajita et al., 1985). This study indicates that it is also beneficial to satisfy individual differences in attitudes. Schunk (1983) has reported that learners' attribution may be amenable to change through training. The teacher's view of their pupils' ability in mathematics and attribution of mathematical outcomes, affects their pupils' attributions, and in turn, influences their preference for different teaching methods. Future research should consider the relationships between the learners' attribution style and their affective attitudes towards mathematics from a multilevel perspective.

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