

Analysis of Preferences and Reality for Teacher-Student Interaction in Secondary School Science Classroom

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Abstract: This study was conducted for the purpose of analyzing the teachers' and students' preferences and reality with regard to their interaction in secondary school science classes. The subjects of this study were 180 teachers and 1,389 students. The contents of the questionnaire for the teachers included the quality of the personal relationships between the teachers and students as well as the teachers' recognition of teaching activities, and the questionnaire for the students dealt with the quality of the personal relationships between the teachers and students as well as the students' perceptions of their classes. The questionnaire responses were divided into preferences and reality for the research. The results are as follows. First, the levels of the teachers' and students' perceptions of their interaction were significantly lower ($p < 0.05$) compared to their preferences with regard to such. Second, the female teachers showed higher levels of preferences and reality compared to the male teachers in the case of the teacher variables, and the middle school teachers showed higher levels of preferences and reality compared to the high school teachers. Third, the male students showed a higher perception level compared to the female students, and both the preferences and reality levels of the middle school students were significantly higher ($p < 0.05$) than those of the high school students. In addition, the level of interaction was lower in big cities than in small cities. Fourth, there was a significant difference between the levels of the teachers' and students' preferences and reality with regard to their interaction.

Key words: preferences, reality, interaction, secondary school, science classroom

I. Introduction

Improvement in the quality of classroom teaching is a prerequisite to improvement in the quality of school education. Among the elements constituting the said high quality of classroom teaching is interaction (Sullivan & Mousley, 1994). From the viewpoint of social constructivism, a great deal of interaction takes place in the course of classroom teaching, and in the learning process, students receive assistance in learning from their peers or teachers (Driver, 1995; Duit & Treagust, 1998), which triggered the research on the interaction occurring in the classroom.

In terms of the interaction taking place in the classroom, it may be viewed at large as being of two kinds: that between the teachers and the students and that between the students and other students. The former appears to be teacher-initiated (Hogan *et al.*, 1999; Lanadale, 1998; Mortimer & Scott, 2000) and to affect the

behaviors and degrees of achievement of the students (Wentzel & Watkins, 2011). It also appears that teacher-student interaction determines the students' level of satisfaction with their respective schools (Baker, 1999). Research studies on the interaction between the students and other students saw vigor in the aspect of cooperative learning, and such interaction appeared to have a significant relation with the students' achievement levels (Anderson *et al.*, 1996; Chang & Lederman, 1994; Kim & Choi, 2009; Sung, 2005).

In terms of the domestic research studies on teacher-student interaction with the use of instructional strategies of formative evaluation, they focused on the following: the effect of the students' school achievement on their attitudes towards science (Park *et al.*, 2000); the effect of class teaching utilizing questions and feedback (Park *et al.*, 2006); and teacher-student interaction based on the type of questions asked

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or feedback given by the teachers (Choi *et al.*, 2004; Park, 2005). The previous studies focused on the aspect of change in linguistic interaction (Nam *et al.*, 2010; Shin, 2007).

Meanwhile, as a major factor determining human behavior, there was an emphasis on the interaction between the environment and the quality of individuals, which led to the introduction of the theory of person-environment congruence (Stern, 1970). This theory hypothesizes that human beings may attain further achievement when their quality and those of their environment are in harmony; in other words, when the former and the latter have a higher level of agreement (Kim, 1994).

In particular, in the course of the teacher-student classroom interaction, a learning environment is created, and the students' achievement grows when the agreement between the students' preferences and the reality is high (Fraser & Fisher, 1983; Kim, 2002). Accordingly, it is expected that the quality of the classroom teaching is high when there is agreement between preferences and reality for the teacher-student interaction.

In this regard, this study purposed to investigate perceptions between preferences and reality of the teacher-student interaction occurred in secondary school science class through a self-evaluation-based questionnaire. The specific research questions of the study are as follows: (1) How different are the preferences and reality with regard to teacher-student interaction according to the teacher variable?; (2) How different are the preferences and reality with regard to teacher-student interaction according to the student variable?; (3) How different are the teachers' and students' perceptions of the teacher-student interaction? Based on the previous studies, the level of perception on preferences and reality for the teachers' and students' teacher-student interaction were investigated, and the results could serve as basic data for measures to enhance the quality of the interaction.

II. Research Methodology

1. Research Subject

As for the teachers, they were those who participated in the training session for secondary school science experiments and for first-class qualification, as well as those from D Metropolitan City and its neighboring areas. As for the teachers' genders, the ratio of the female teachers to the male teachers was nearly twofold, with the male teachers numbering 58 (32.2%) and the female teachers 122 (67.8%). As for the school levels where they teach, the middle school teachers numbered 117 (65.0%), and the high school teachers 63 (35.0%). In terms of their majors, 69 majored in physics (38.3%), 29 in chemistry (16.1%), 64 in biology (35.6%), and 18 in earth science (10.0%).

As for the students, they were evenly selected from metropolitan cities, small and medium-sized cities, and regions, considering the quality of each school seat. The total number of participating schools was 16: 8 middle schools and 8 high schools. As for the middle schools, 1 from each class in 1st to 3rd grade by school was sampled, totaling 3 from each middle school. As for the high schools, 1 from each class in 1st to 2nd grade was sampled, totaling 2 from each high school. There were as many male students as female students: 695 (50.0%) and 694 (50.0%), respectively. As for the school level, there were 846 (60.9%) middle school students and 543 (39.1%) high school students, with a higher number of middle school students because the 3rd-grade high school students were excluded from the study. In terms of school seat, there were 819 (59.0%) large cities, 289 (20.8%) small and medium-sized cities, and 281 (20.2%) region.

2. Questionnaire

The questionnaires that were used in the study, which were designed based on the self-evaluation guidelines of NSTA (National Science

Teachers Association, 1987), were based on a teacher–student interaction survey. It was revised and complemented to suit the realities in South Korea, through consultation with science education experts and 5 science teachers.

The questionnaire items were classified into 2 types: those for the teachers and those for the students. The questionnaire items for the teachers touched on the quality of the personal relationships between the students and the teachers which may be thus interpreted affective quality (17 items) and the teachers' perceptions of their instruction which may be thus interpreted cognitive quality (35 items). The questionnaire items for the students also touched on the quality of the personal relationships between the students and teachers (17 items) but touched as well on the students' perceptions of their lessons (35 items). As for the responses to each questionnaire item, they consisted of two types: preferences and reality. The responses were scored based on a 5-point Likert scale (appendix).

The quality of the personal relationships between the students and the teachers included an allowable environment in a small-group learning class, understanding of and respect for the students, and respect for the teachers' and students' opinions. Between teachers' perceptions and students' perceptions of their lessons are basically identical. They were as follows: a variety of student class activities, the teachers' preferences with regard to student achievement, debates and discussions, experiments, small-group research, and evaluation.

A science education doctoral-degree holder and 5 science education doctoral course students were commissioned to validate the teacher and student questionnaires that were completed first. The results showed that the teacher and student questionnaires had 82.2 and 84.4% validity, respectively. Based on the validity test results and on the results of the consultation with a science education expert, the final versions of the questionnaires were completed

following the revision and complementation of the questionnaire items. The completed survey questionnaires were preliminarily tested with 10 teachers and 32 students. The reliability test results showed Chronbach's α values of 0.973 and 0.963 for the teacher and student questionnaires, respectively.

3. Data Collection and Analysis

To analyze the perceptions on the teacher–student interaction in middle school science class, a total of 220 teacher questionnaires were distributed by mail and e-mail. Of the 220, 187 accomplished questionnaires were collected, accounting for an 85% recovery rate. Of the 187, 7 were incomplete. As such, a total of 180 accomplished questionnaires were analyzed. As for the student's questionnaires, they were mailed to the subject students from the contacted schools. A total of 1,401 questionnaires were returned, including 12 incomplete questionnaires. Thus, 1,389 questionnaires were analyzed.

As for the responses to each questionnaire item, the respondents were made to give 2 response types: "preferences" and "reality." The following scores were given, based on the 5-point Likert scale: 5 points for "strongly agree," 4 for "agree," 3 for "neutral," 2 for "disagree," and 1 point for "strongly disagree." Accordingly, 5 points was the highest possible score for each item. As the items on the teachers' perceptions and the students' perceptions of their lessons basically had the same contents, the teachers' and students' responses to such items were compared in the results analysis.

III. Findings and Discussion

1. Perception Gap on Interaction by Teacher Variable

To investigate the teachers' perceptions on the teacher–student interaction in science class, t–

test was carried out on the preferences and reality according to area, and the results are shown in (Table 1).

With regard to the quality of the personal relationships between the students and teachers, the teachers' and students' preferences showed a higher than the teachers' and students' reality, and the difference between the preference and reality was significant ($p < 0.05$). The teachers' perceptions of their lesson scored lower than their preferences, and the difference was significant ($p < 0.05$). This indicates that the anticipated execution is far lower than the perception with regard to the importance of teacher-student interaction.

1) Gender analysis results

To analyze the difference between the teachers' preferences and reality by gender for each item, t-test was carried out, and the results are shown in (Table 2).

In terms of preferences with regard to the quality of the personal relationships between the students and teachers, the female teachers obtained a higher than the male teachers, but the difference was not significant. For the teachers' perceptions of their lesson, the female teachers obtained a higher average score than the male teachers, and the difference between the genders was significant ($p < 0.05$).

In terms of teachers' perceptions of their

Table 1

Difference of preferences and reality by teacher variable (N=180)

	preference		Reality		t-value
	M	SD	M	SD	
The characteristic of personal relationships between the students and teachers	83.55	9.48	69.84	9.97	19.297*
Teachers' perceptions of their lesson	142.96	17.94	118.87	17.12	18.819*
Total	226.51	26.42	188.71	26.04	19.757*

* $p < 0.05$

Table 2

Difference of preferences and reality by gender (N=180)

		preference		t-value	reality		t-value
		M	SD		M	SD	
The characteristic of personal relationships between the students and teachers	male	82.10	9.19	-1.416	68.67	9.45	-1.088
	female	84.24	9.57		70.39	10.14	
teachers' perceptions of their lesson	male	138.43	17.67	-2.362*	115.53	18.08	-1.815
	female	145.11	17.74		120.46	16.48	
Total	male	220.53	25.70	-2.111*	184.21	26.50	-1.607
	female	229.34	26.39		190.85	25.66	

* $p < 0.05$

lesson (actual class) with regard to the quality of the personal relationships between the students and teachers, the female teachers obtained a higher than the male teachers. Also, for the teachers' perceptions of their lesson, the female teachers obtained a higher than the male teachers. The differences in both areas, however, were not significant ($p > 0.05$). This suggests that the female teachers have a higher perception of their lesson but the differences between the genders were not significant.

2) Analysis results by school level

The school levels were grouped into middle and high school, and t-test was carried out to investigate the perception gap between the preferences and reality. The results are shown in (Table 3).

As for the teachers' preferences with regard to the quality of the personal relationships between the students and the teachers, the middle school teachers obtained a higher than the high school teachers, but the difference between middle school teacher and high school teacher was insignificant. For the teachers' perceptions of their lesson, the middle school teachers obtained a higher than the high school teachers, and the difference was significant ($p < 0.05$).

As for the teachers' perceptions of their lesson with regard to the quality of the personal

relationships between the students and teachers, the middle school teachers obtained a higher than the high school teachers, but the difference was insignificant. For the teachers' perceptions of their lesson, the middle school teachers obtained a higher than the high school teachers, and the difference was significant ($p < 0.05$).

For the teachers' perceptions of their lesson, the middle school teachers obtained a significantly higher average score than their high school counterparts, which logically suggests that there is more active interaction between the teachers and the students in middle school. These results were consistent with the finding of previous studies (Kim, 2000). Moreover, the said results appear to be connected with the study results that the decreased interaction in the higher school levels has to do with the lower achievement as well as with the decreased interest in and pleasure from science (Kim *et al.*, 1999; Kwak *et al.*, 2006).

3) Analysis results by major

The majors were grouped into four: physics, chemistry, biology, and earth science. To analyze the perception gap on teacher–student interaction by major, one-way ANOVA was carried out, and the results are shown in (Table 4).

In terms of preferences, the average total scores obtained were in the following order:

Table 3

Difference of teachers' perceptions of between preferences and reality by school level (N=180)

		preference			reality		
		M	SD	t-value	M	SD	t-value
The quality of personal relationships between students and teachers	middle school	83.92	9.77	0.719	70.01	10.10	0.312
	high school	82.86	8.95		69.52	9.67	
Teachers' perceptions of their lesson	middle school	144.94	17.49	2.040*	120.72	17.42	1.987*
	high school	139.27	18.34		115.44	16.13	
Total	middle school	228.86	26.47	1.639	190.73	26.54	1.419
	high school	222.13	25.98		184.97	24.87	

* $p < 0.05$

biology>physics>chemistry>earth science, and the differences was significant in both areas and in the total values ($p < 0.05$). To determine which groups showed a difference, Turkey verification was carried out. In the teachers' perceptions of their lesson, there were a significant difference between biology and earth science.

As for the reality, the average total scores obtained were in the following order: earth science>chemistry>biology>physics, but the differences were not significant ($p > 0.05$). As there were inconsistencies in the order of preferences and reality, and as there were no significant differences in terms of the reality, it can be said that there were differences in the teachers' perceptions of teacher-student interaction by major, but that there were no differences in the execution.

2. Perception Gap on Teacher-Student Interaction by Student Variable

To analyze the students' perceptions of the

teacher-student interaction in science class, t-verification was carried out on the students' preferences and reality by area, and the results are shown in (Table 5).

On the quality of the personal relationships between the students and teachers, the students' preferences showed a higher than the students' perceptions of their lessons(reality), and the difference was significant ($p < 0.05$). In the students' perceptions of their lessons, the students' preferences showed a higher than the students' perceptions, and the difference was significant ($p < 0.05$). The same pattern appeared for the total values, which indicates that the execution falls behind the students' preferences in relation to the importance of teacher-student interaction.

1) Analysis by gender

To analyze the perception gap between the students' preferences and reality by gender for each item, t-test was carried out, and the results are shown in (Table 6).

Table 4
Difference of preferences and reality by major (N=180)

		preference			reality		
		M	SD	F	M	SD	F
The characteristic of personal relationships between students and teachers	physics	82.81	9.49	2.903*	69.42	10.74	1.207
	chemistry	81.14	9.18		68.45	7.55	
	biology	86.16	8.39		69.80	9.31	
	earth science	81.00	11.89		73.83	11.80	
Teachers' perceptions of their lesson	physics	140.65	18.21	3.146*	116.99	18.58	1.265
	chemistry	142.28	16.95		121.00	12.81	
	biology	147.86	16.52		118.19	16.15	
	earth science	135.44	20.17		125.11	20.08	
Total	physics	223.46	26.71	3.139*	186.41	28.45	1.134
	chemistry	223.41	25.72		189.45	19.49	
	biology	234.02	23.54		187.98	24.20	
	earth science	216.44	31.30		198.94	31.18	

* $p < 0.05$

Table 5
Difference of preferences and reality by student variable (N=1389)

	preference		reality		t-value
	M	SD	M	SD	
The characteristic of personal relationships between students and teachers of their lesson	64.27	11.62	58.99	11.14	17.495*
Students' perceptions of their lesson	132.93	23.66	122.13	22.50	17.455*
Total	197.20	34.08	181.11	32.42	18.270*

*p<0.05

In the case of the students' preferences with regard to the quality of the personal relationships between the students and teachers, the female students obtained a higher than their male counterparts, but the difference was insignificant. For the students' perceptions of their lessons, the female students obtained a higher than their male counterparts, but the difference was not significant.

As for the students' perceptions of their lessons (reality) with regard to the quality of the personal relationships between the students and teachers, the male students obtained a higher than their female counterparts, and the difference was not significant. For the students' perceptions of their lessons, the male students obtained a higher than their female counterparts, and the difference was

significant (p<0.05). The same can be said for the total values.

It is assumed that the reason for the male students' significantly higher perceptions on reality for the teacher–student interaction in science class is connected with the result of the study conducted by Kwak *et al.* (2006), that the male students have a higher degree of interest in science than the female students, and with the result of the study conducted by Park (2005), that the class participation of the male students is higher than that of their female counterparts, and that female students have greater difficulty in science class.

2) Analysis results by school level

T-test was carried out to investigate perception

Table 6
Difference of students' perception of preferences and reality by genders (N=1389)

		preference			reality		
		M	SD	t-value	M	SD	t-value
The characteristic of personal relationships between students and teachers	male	63.99	12.45	-0.922	59.43	11.69	1.472
	female	64.56	10.72		58.55	10.55	
Students' perceptions of their lesson	male	132.62	25.04	-0.489	123.63	23.26	2.497*
	female	133.24	22.21		120.62	21.62	
Total	male	196.60	36.21	-0.653	183.06	33.55	2.238*
	female	197.80	31.82		179.17	31.16	

*p<0.05

gap between the students' preferences and reality, and the results are shown in (Table 7).

In terms of the average total score for preferences, the middle school students obtained a higher value compared to the high school students, and the difference between both areas and the total values was significant ($p < 0.05$). Moreover, for the average total score for perceptions, the middle school students obtained a higher value than the high school students, and the difference was significant in all the areas ($p < 0.05$). That is, as shown in (Table 4), the results are the same as those by the teachers' school level. As such, it can be said that overall, there is more active teacher-student interaction in middle school science class. This seems connected with the results of the previous studies that the higher school level is, the lower the students' interest in and pleasure from science (Kwak et al., 2006). And high school students' science attitude has declined more than elementary and middle school students (Kwon et al., 2004).

3) Analysis results by school seat

The seat of the subject schools were grouped

into three: large cities, small and medium-sized cities, and regions. To investigate the differences in the students' preferences and reality by school seat, one-way ANOVA was carried out, and the results are shown in (Table 8).

As for the preferences, the average total scores obtained were in the following order: regions > large cities > small/medium-sized cities. For the quality of the personal relationships between the students and teachers, the average total scores showed a significant difference ($p < 0.05$). To analyze the difference between the 2 groups, Turkey verification was carried out. The results showed that there exists a significance difference between the large cities and the regions in terms of the quality of the personal relationships between the students and teachers and the total values ($p < 0.05$).

For the reality, the average total scores obtained were in the following order: small/medium-sized cities > regions > large cities, and the differences were significant in all the items ($p < 0.05$). Following Turkey verification, there appeared a significant difference between the large cities and the small and medium-sized cities, and between the large cities and the

Table 7

Difference of students' perceptions of preferences and reality by school level (N=1389)

		preference			reality		
		M	SD	t-value	M	SD	t-value
The characteristic of personal relationships between students and teachers	middle school	65.79	11.60	6.154*	61.06	10.68	8.901*
	high school	61.91	11.25		55.76	11.08	
Students' perceptions of their lesson	middle school	136.02	23.55	6.164*	127.16	21.58	10.831*
	high school	128.11	23.04		114.29	21.67	
Total	middle school	201.81	34.00	6.382*	188.22	31.10	10.596*
	high school	190.02	32.98		170.04	31.35	

* $p < 0.05$

Table 8
Difference of preferences and reality by school seat (N=1389)

		preference			reality		
		M	SD	F	M	SD	F
The characteristic of personal relationships between students and teachers	Large cities	63.72	11.85	3.076*	57.85	11.35	11.800*
	Small/medium-sized cities	64.48	11.73		61.32	11.25	
	Regions	65.69	10.69		59.91	9.92	
Students' perceptions of their lesson	Large cities	132.16	23.90	2.973	120.27	23.20	7.349*
	Small/medium-sized cities	132.10	24.39		125.73	21.77	
	Regions	136.00	21.99		123.82	20.59	
Total	Large cities	195.88	34.70	3.100*	178.12	33.47	9.371*
	Small/medium-sized cities	196.58	34.71		187.05	31.56	
	Regions	201.68	31.25		183.73	29.05	

* $p < 0.05$

regions, in terms of the quality of the personal relationships between the students and teachers, and the total values ($p < 0.05$). As for the students' perceptions of their lessons, there appeared a significant difference between the large cities and the small and medium-sized cities ($p < 0.05$).

Compared with previous studies, whose cities or suburbs show higher-quality science classes than the rural areas (Kwon *et al.*, 2004; Weiss *et al.*, 2003), this study showed a lower level of teacher–student interaction in the large cities than in the small and medium-sized cities and regions. This is assumed to be due to the fact that in the large cities, there are more students in science classes.

3. Perceptions Gap between the Teachers' and Students' on Teacher–Student Interaction

To analyze the perception gap between the teachers' and students' on teacher–student interaction in middle school science class, *t*-test was carried out by item, and the results are shown in (Table 9).

As for the preferences with regard to the quality of the personal relationships between the teachers and students, the average score obtained by the teachers was higher than that obtained by the students. Moreover, with regard to the students' perceptions of their lessons, the average score obtained by the teachers was higher than that obtained by the students, and the difference was significant ($p < 0.05$).

As for the reality with regard to the quality of the personal relationships between the teachers and students, the average score obtained by the teachers was higher than that obtained by the students. Moreover, with regard to the students' perceptions of their lessons, the average score obtained by the teachers was higher than that obtained by the students. The difference between the said areas and the total values was significant ($p < 0.05$). This suggests that the students' perceptions of teacher–student interaction are lower than those of the teachers. As a difference exists between the teachers' and students' perceptions of the teaching and learning methods by class circumstance (Seo *et al.*, 2010), it appears that a difference exists

Table 9

Difference of preferences and reality between students and teachers (No. of teachers=180, No. of students=1389)

		preferences			reality		
		M	SD	t-value	M	SD	t-value
The characteristic of personal relationships between students and teachers	teacher	74.75	8.58	11.692*	62.87	9.02	4.491*
	student	64.27	11.62		58.99	11.14	
Students' perceptions of their lesson	teacher	151.76	18.87	10.261*	125.84	18.06	2.127*
	student	132.93	23.66		122.13	22.50	
Total	teacher	226.51	26.42	11.109*	188.71	26.04	3.020*
	student	197.20	34.08		181.11	32.42	

* $p < 0.05$

between the teachers and students.

So far, this study examined the differences between the teachers' and students' perceptions of the teacher–student interaction in middle school science class. A close look into the differences in perceptions of teacher–student interaction by teacher variable revealed that the female teachers obtained higher average scores in both preferences and reality compared with their male counterparts. It can thus be said that the female teachers have higher perceptions of teacher–student interaction as well as a higher degree of execution in class, compared with their male counterparts. As for the school level, the middle school teachers obtained a higher average score in both their preferences and reality of their instruction, compared with their high school counterparts. This is consistent with the result of a previous study, that the interest in and pleasure from science decreases in the higher school levels (Kwak *et al.*, 2006).

A look into the perception gap of teacher–student interaction by student variable revealed that the male students obtained a significantly higher average score than the female students. This may be viewed in the same vein as the male students' higher interest in science compared to the female students (Kwak *et al.*, 2006), and the

male students' higher class participation and the female students' greater difficulty in science class (Park, 2005). According to the school level, the middle school students obtained higher average scores for preferences and reality compared to the high school students. The same is true for the teachers and may be seen to be associated with the result of the study conducted by Kwak (2006), that the higher the school level is, the lesser the interest is linked to the pattern of teacher–student interaction. According to the school location, regions showed higher average scores for reality compared with the large and small/medium-sized cities, which may be because in the regions, each class has fewer students.

A close look into the average scores obtained for teacher–student interaction preferences and reality revealed that the students' average scores for preferences and reality in all the items were lower than those of the teachers. It was thus found that the teachers' execution falls behind the students' preferences. Thus, the teachers should adopt measures to reduce this gap and to enhance the teacher–student interaction in the classroom like verbal interaction or enhancing the feedback(Choi *et al.*, 2004; Lee *et al.*, 2000).

IV. Conclusions and Suggestions

In this study, the teachers' and students' perceptions of the teacher–student interaction in science class were analyzed, and such preferences and reality were analyzed according to the teachers' and students' quality. As for the difference between the teachers' and students' perceptions, it was analyzed by classifying the respondents' responses into preferences and reality. The findings are followings.

First, both the teachers' and students' perceptions on the teacher–student interaction in science class showed lower significance compared to the preferences ($p < 0.05$). This suggests that the actual teacher–student interaction in science class falls behind the preferences, thus pointing to a need to come up with measures to promote teacher–student interaction.

Second, according to the teachers' gender, the female teachers obtained higher average scores in both preferences and reality compared to their male counterparts. According to the school level, the middle school teachers obtained higher average scores in both preferences and reality compared to their high school counterparts, and the difference in the teachers' perceptions of their instruction was significant ($p < 0.05$). This implies that in secondary school the higher the school level is, the lower the level of achievement and attitude resulting from the teacher–student interaction. Teachers' quality, teachers' preference and interaction between teacher and student are needed to improve students' science attitude (Reynalds & Walberg, 1991).

Third, according to the student variable, the male students obtained a high average score in actual class compared with their female students ($p < 0.05$). By school level, the middle school students obtained significantly higher average scores in both preferences and reality compared with the high school students ($p < 0.05$). This seems connected with the findings that the

female students have a lower degree of achievement and attitude in science compared with their male counterparts, and that in secondary school the higher the school level is, the lesser the interest in science is linked to teacher–student interaction. This calls for the development of instructional strategies to enhance the interaction between the teachers and the female students, and to promote more vigorous teacher–student interaction in high school.

Fourth, in both the preferences and reality of the teacher–student interaction in science class, the students' scores showed lower significance compared with those of the teachers ($p < 0.05$). This shows that there still exists a difference between the teachers' and students' perceptions. Aspect of science teachers influenced on students' science attitude change, science teachers' role is definite (Kim & Yang, 2005; Kwon *et al.*, 2004). This is anticipated, based on the previous conclusions, that advanced studies will be conducted on specific measures that can be adopted to enhance the teacher–student interaction in science class.

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