



Perceived teacher factors in relation to students' achievement-related outcomes in science classrooms in elementary school

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Abstract

The purpose of the current study was to investigate the roles that perceived teacher affective support (PTAS), perceived teacher mastery goal orientation (PTMGO), academic emotions, self-efficacy and behavioural engagement play on students' science achievement in elementary school science classrooms. The potential relations of different levels of perceived teacher factors with students' achievement-related outcomes were also investigated. A total of 138 fourth- and fifth-grade students in Istanbul, Turkey were participated in the study. The data was analysed using hierarchical regression, univariate and post hoc analyses. Findings showed that PTAS, academic anxiety and academic self-efficacy were the significant predictors of students' science achievement in elementary school classrooms, controlling for gender and grade level. Students grouped in High PTAS/High PTMGO outperformed students in other groups and reported significantly greater sense of belonging, higher academic enjoyment, lower academic anxiety, greater academic self-efficacy and behavioural engagement and received higher science grades compared to students grouped in Low PTAS/Low PTMGO. Implications for research and school practice are discussed.

Key words: Perceived teacher affective support (PTAS), perceived teacher mastery goal orientation (PTMGO), academic emotions, academic self-efficacy, behavioural engagement, science achievement.

Introduction

In learning environments, students' psychological satisfaction and motivation have received rare attention from educators for years. The pressure that school administrators and educators experienced to achieve higher achievement in standardized tests has led schools to be more concerned about identifying and applying cognitive strategies that improve students' cognitive capacities and academic success (Agüero & Beleche, 2013; Kohn, 2000). Therefore, schools have often overlooked the necessity of satisfying students' psychological needs. Research, however, shows that the contextual characteristics and, especially, the psychological and motivational climate of classrooms influence students' learning behaviours, goal orientations, self-beliefs, attributions, strategy use, academic and social motivation, emotional functioning and academic achievement in various academic fields throughout different developmental levels (Ames, 1992; Boekaerts, 2002; Linenbrink & Pintrich, 2002; Meyer & Turner, 2002; Patrick & Middleton, 2002; Perry & VandeKamp, 2000; Roeser, Eccles, & Sameroff, 1998; Stipek et al., 1998). Therefore, more attention needs to be paid to psychosocial, emotional, and motivational factors in learning environments.

In the current study, perceived teacher affective support (PTAS), perceived teacher mastery goal orientation (PTMGO), sense of belonging, academic enjoyment, academic anxiety, self-efficacy and behavioural engagement were examined in relation to students' science achievement in elementary schools. Also, the impacts of different levels of perceived teacher factors on students' emotional, motivational and academic functioning in science classrooms were investigated.

Perceived teacher affective support (PTAS)

Research shows that establishing emotionally supportive learning environment is an important requirement for students' motivation and challenge in learning (Turner & Meyer, 2004). In emotionally supportive learning environments, students feel relaxed and joyful (Patrick, Turner, Meyer, & Midgley, 2003). Research findings reveal that perceived teacher affective behaviours positively relate to students' academic self-concept and intrinsic motivation in learning (Skaalvik & Skaalvik, 2013). Showing care and concern for students and spending time on knowing them have positive influences on students' participation and effort in learning (Tucker et al., 2002). Especially, in competitive learning environments, affective teacher behaviours gain more importance for students' well-being and academic functioning (Chen, 2005). Hughes and Chen (2011) reported that students having higher quality affective relations with their teachers in the second grade classrooms have more positive relations with their peers in the third grade, which eventually relate to more positive relations with teachers in the fourth grade and improve academic self-efficacy in the fifth grade. Hughes and Chen (2011) used teacher reports for the measurement of given relations but they indicated the necessity of taking students' perspectives as well.

Using a self-report questionnaire, Sakiz, Pape, and Hoy (2012) measured the relations between PTAS and students' outcomes in mathematics classrooms in middle schools. The affective characteristics of teachers were identified as caring, concern for students, listening, high expectations, valuing, fairness, recognition and encouragement. The results showed that PTAS significantly positively related to seventh- and eighth-grade students' sense of belonging, academic enjoyment, academic hopelessness, academic self-efficacy and academic effort in mathematics classrooms.

Midgley and Edelin (1998) suggest that teacher affective behaviours should be accompanied with teacher mastery goal orientation in classrooms. Supporting this proposition, in a recent study, Skaalvik and Skaalvik (2013) found highly strong positive correlation between teacher mastery goal orientation and perceived teacher emotional support for Norwegian elementary to high school students. Therefore, affective support and mastery goal orientation can be considered positive teacher factors improving students' positive outcomes in classrooms.

Perceived teacher mastery goal orientation (PTMGO)

Research suggests that supportive, caring, and mastery-oriented school environments stimulate more adaptive cognitive, emotional, and behavioural outcomes compared to less supportive and performance oriented environments (Roeser, Midgley, & Urdan, 1996). Roeser and his colleagues (1996) suggest that schools and teachers need to be more mastery oriented. Teachers' mastery oriented behaviours such as encouraging academic interest in classroom materials, being flexible for failures and mistakes and guiding students for focusing more on their own performance instead of others' performances improve students' learning (Fryer & Elliot, 2008).

In mastery oriented classrooms, students focus more on learning, development, improvement, and understanding; they use more effective learning strategies and prefer more challenging tasks, demonstrate less disruptive behaviours while in performance oriented classrooms, students focus more on doing better than others, demonstrate behaviours leading to recognition, praise, and higher confidence; they use less effective learning strategies, less effort, and prefer easy tasks and demonstrate more disruptive behaviours (Ames & Archer, 1988; Kaplan, Gheen, & Midgley, 2002; Midgley & Edelin, 1998; Ramnarain, 2013; Ryan, Pintrich, & Midgley, 2001; Skaalvik & Skaalvik, 2013). The findings of a study conducted in Taiwanese junior high school classrooms showed that mastery oriented students participate and resist more in learning activities, demonstrate more curiosity and enjoyment and less anxiety and boredom in class activities (Shih, 2008).

Previous research conducted in the United States and Norway revealed that middle school students reporting mastery goal orientation and teacher support demonstrate less self-handicapping disruptive behaviours and anxiety, greater self-concept, seek more help and avoid cheating behaviours in tests (Patrick et al., 2003; Ryan, Gheen, & Midgley, 1998; Skaalvik & Skaalvik, 2013). In a recent study, perceived teacher support and PTMGO were reported to be significantly positively related to students' academic performance in Portuguese secondary school classrooms (Moreira, Dias, Vaz, & Vaz, 2013). Although most studies report a positive link between mastery goal orientation and academic success, Gherasim, Butnaru, and Mairean (2013) did not find a significant relation between mastery goal orientation and academic achievement outcomes of students in secondary classrooms in Romania. In the study of Gherasim et al. (2013), teacher support was found to be a significant predictor of students' mathematics achievements for both genders and positively related to peer support. Studies related to support and goal orientation are mostly conducted in middle school environments and do not provide consistent results in terms of the effects of teacher support and mastery goal orientation on students' outcomes. Therefore, more research considering different developmental levels is needed.

Sense of belonging

According to Maslow's (1968) theory of hierarchy of needs, proper, adequate, and timely satisfaction of the need for belongingness promote emotional, physical, behavioural, and mental functioning of individuals. In schools, sense of belonging refers to students' feelings of being valued, recognized and encouraged by others in learning environments (Goodenow, 1993). Sense of belonging contributes significantly to students' learning and motivation in educational environments. Belongingness and sense of support decrease drop-out rates in schools (Finn, 1989), increase school attendance (De Wit, Karioja, & Rye, 2010), improve academic self-efficacy (McMahon, Wernsman, & Rose, 2009), relate positively to students' perceived academic achievement in various cultures (Samdal, Wold, & Bronis, 1999) and even improve psychosomatic health among students (Modin & Östberg, 2009).

Teachers' affective behaviours such as caring, respect, fairness and encouragement positively respond to students' needs for belongingness to classroom and school community (Osterman, 2010). Especially at elementary school ages, teachers are major social links for students to connect with peers and others in schools. Therefore, teachers are expected to pay greater attention to their affective practices when they interact with their students. Also, encouraging mastery goal orientation may be essential for improving sense of belongingness in class, given that focusing more on learning decreases the pressure on students to compete with each other, which is often observed in performance goal oriented classrooms. The relationship between belongingness and mastery goal orientation needs to be examined in elementary school classrooms.

Academic emotions

One of the major challenges of today's education is to improve positive emotions in children and decrease negative ones (Cigman, 2012). In their longitudinal study, Skinner et al. (2008) showed that emotional variables such as interest, enjoyment and anxiety predict behavioural functioning of students from fourth- through seventh- grades. At the time when students lose their enjoyment and interest in learning, they show difficulty in sustaining their behavioural engagement in tasks; and, similarly, when they experience anxiety, they show more avoidance behaviours toward learning (Skinner et al., 2008). Skinner and her colleagues (2008) indicated that teachers' efforts for enhancing students' behavioural engagement without involving positive emotions may not have a long-lasting impact on high-quality engagement of students in educational activities.

Lumby (2011) reported that weak teacher-student relations increase stress in learning environments which undermines students' academic enjoyment leading to school failure. Academic enjoyment can also be enhanced through mastery goal oriented classrooms (Barkoukis, Koidou, Tsorbatzoudis, &

Grouios, 2012). In mastery oriented learning environments, students' experience less emotional distress because they perceive their environment warm, caring, and socially supportive as well as academically challenging (Roesser et al., 1996). On the other hand, in nonsupportive and performance goal oriented classrooms students' anxiety level may increase significantly (Patrick et al., 2003). The pressure to receive high grades boosts students' anxiety (Wiest, Wong, Cervantes, Craik, & Kreil, 2001). Therefore, it is expected that PTAS accompanied with PTMGO would relate positively to academic enjoyment and negatively to academic anxiety in learning environments.

Academic self-efficacy

Self-efficacy is simply defined as "beliefs about whether one can produce certain actions" to attain certain goals (Bandura, 1997, p. 20). Lorschach and Jinks (1999) suggested that self-efficacy, unlike most other personal beliefs, can be accessed from and affected by learning contexts. Komarraju (2013) found that students with lack of academic self-efficacy benefit more from caring teacher behaviours (e.g. encouragement and compassion). Stipek and Daniels (1988) suggested that mastery goal oriented feedback may positively improve students' self-efficacy beliefs.

The positive link between academic self-efficacy and science achievement in elementary classrooms was reported in several research (Phan, 2012; Shen & Pedulla, 2000). On the other hand, the factors influencing students' perceived self-efficacy beliefs show differences based on the academic discipline. For example, in their study, McMahan et al. (2009) found that classroom environment and school belongingness increased elementary school students' self-efficacy in language arts but those variables were not related to self-efficacy in mathematics and science. The meta-analysis of Huang (2013) showed that male students feel more efficacious in mathematics, social sciences and computer while female students experience greater self-efficacy in language arts. Huang (2013) reported a small effect size regarding the relation between gender and academic self-efficacy, favouring male students. In the study of Uçak and Bağ (2012), girls were found more self-efficacious in performing tasks in science and technology classes than do boys in middle school classrooms in Turkey. Most research on self-efficacy focused on middle school and beyond. The information on the sources and outcomes of self-efficacy beliefs of students in elementary schools is still rather limited.

Behavioural engagement

Students who are behaviourally engaged in learning environments pay more attention, show greater effort and persistence and demonstrate higher voluntary participation in their learning process (Fredricks, Blumenfeld, & Paris, 2004). In their research, Klem and Connell (2004) reported that behaviourally engaged students are more likely to perform well and commit strongly in reading and mathematics in elementary school classrooms. They also found that caring learning environments with high, clear and fair expectations are significantly positively associated with students' higher engagement leading to higher attendance and better performance in given subjects. Similarly, based on a meta-analysis, Roorda et al. (2011) reported that affective dimensions of perceived teacher support can advance students' school engagement and achievement in different developmental levels. Van Ryzin (2011) showed that engagement not only significantly positively relate to students' achievement in challenging courses but also increase their hope for success.

Wang and Holcombe (2010) found that perceived teacher social support and PTMGO in seventh-grade were significant predictors of students' engagement in eight-grade, relating positively to their academic achievement. Dotterer and Lowe (2011) showed that the relation between perceived classroom context (instructional quality, social-emotional climate and teacher-student conflict) and academic achievement can be mediated through behavioural engagement in the fifth-grade classrooms. The given research reveals the importance of increasing students' behavioural engagement in elementary school years.

Science classrooms

Research consistently shows a decline in students' interest in science-related courses and engaging in science activities (Convert, 2005; Osborne, Simon, & Collins, 2003; Swarat, 2008). The reports published by PISA (OECD Programme for International Student Assessment) reveal inadequate science proficiency of students in many countries throughout the world, especially in developing countries, including Turkey (OECD, 2007; 2010). Similar findings were also presented in TIMMS reports (Trends in International Mathematics and Science Studies), one of which announced recently based on TIMMS 2011 data (Yücel, Karadağ, & Turan, 2013). Therefore, more research needs to be dedicated to find ways to increase students' science engagement and achievement. Ozel, Caglak, and Erdogan (2013) examined the factors related to Turkish students' science achievement using PISA 2006 data. The findings showed that the most influential factor related positively to Turkish students' science achievement was enjoyment of science. A similar finding was also reported for students in Malaysia and Singapore using TIMMS 2007 data (Ng, Lay, Areepattamannil, Treagust, & Chandrasegaran, 2012). Enhancing enjoyment in science classrooms seems to be crucial to improve students' interest and achievement in science but other potentially related factors need to be examined as well. For example, Sakiz et al. (2012) found that perceived teacher affective behaviours improve middle school students' mathematics-related enjoyment and motivation. A recent research showed that teacher mastery goal orientation is positively linked to students' interest and enjoyment in learning in Israel (Butler & Shibaz, 2013). Moreira et al. (2013) reported that perceived teacher support and PTMGO are positively associated with students' academic performance in middle school classrooms in Portuguese. As often indicated, most of these studies were conducted in middle schools. Given that students' positive attitude toward science is primarily built during elementary school years (Shapiro, 1994), students at this developmental stage should also be included in related investigations.

Current study

The purpose of the current study was to investigate the roles that perceived teacher affective support (PTAS), perceived teacher mastery goal orientation (PTMGO), perceived sense of belonging, academic enjoyment, academic anxiety, academic self-efficacy and behavioural engagement play on students' science achievement outcomes in elementary school science classrooms in Turkey. Additionally, the relations of different levels of perceived teacher factors with students' given emotional, motivational and behavioural outcomes as well as their achievement in science were investigated.

Method*Participants and procedure*

The participants were 138 fourth- and fifth-grade students ($n_{\text{fourth}} = 65$; $n_{\text{fifth}} = 73$) in four classrooms in an elementary school in the Anatolian side of Istanbul. The ages of students were ranged from 9 to 13 ($M = 10.57$, $SD = 0.64$); 67 of them were female and 71 were male. Each classroom was instructed by one teacher. The socio-economic levels of the parents in the district ranged from lower middle class to middle class. Students responded to self-report questionnaire, which includes a five-point Likert-type scale ranging from (1) not at all true to (5) completely true, in their science and technology classrooms. Before the survey administration, students were given a brief instruction about the study and were reminded about the confidentiality of their responses. Students' achievement scores in science were obtained from the school data. The classroom teachers granted the final science grades at the end of the school year based on students' academic performances in science tests, exams and projects throughout the semester.

Measures

Perceived Teacher Affective Support Subscale. This subscale contains 12 items. Nine items were adapted from Sakiz (2007) and the other three items were developed based on related research. A sample item

is "In this science and technology class, my teacher recognizes and appreciates when I am good at something." The internal consistency reliability estimate is .86.

Perceived Teacher Mastery Goal Orientation Subscale. This subscale includes four items adapted from the *Patterns of Adaptive Learning Scales* (PALS, Midgley et al., 1995). A sample item in this subscale is "In this science and technology class, our teacher wants us to understand what we do, not just memorize it." The internal consistency reliability estimate of this subscale is .63.

Sense of Belonging Subscale. This subscale contains seven items obtained from Sakiz (2007), which includes six items adapted from *Psychological Sense of School Membership Scale* developed by Goodenow (1993) and one item taken from PALS (Midgley et al., 1995). A sample item is "Students in this class value my ideas." The internal consistency reliability estimate of this subscale is .82.

The Academic Enjoyment Subscale. This subscale includes four items obtained from Sakiz (2007), which is adapted from the *Academic Emotions Questionnaire* (AEQ) (Pekrun et al., 2005). A sample item is "It feels like time flies when I am in this science and technology class." The internal consistency reliability estimate of this subscale is .70.

The Academic Anxiety Subscale. This subscale includes seven items adapted from the *Academic Emotions Questionnaire* (AEQ) (Pekrun et al., 2005). A sample item is "When I don't understand something important in this science and technology class, my heart races." The internal consistency reliability estimate of this subscale is .88.

Academic Self-efficacy Subscale. This subscale includes six items and adapted from *The Motivated Strategies for Learning Questionnaire* (Pintrich, Smith, Garcia, & McKeachie, 1991). A sample item in this subscale is "I am certain that I can do an excellent job on the assignments in this science and technology class." The internal consistency reliability estimate of this subscale is .84.

Behavioural Engagement Subscale. This subscale contains eight items. Five items were modified from Sakiz (2012) and three items were developed based on related research. A sample item in this subscale is "In this science and technology class, even the concepts are boring I keep working." The internal consistency reliability estimate of this subscale is .69.

Data analyses

The data was analysed using hierarchical regression analysis to examine the associations between given variables of the study and science achievement. The relations of different levels of perceived teacher factors with students' emotional, motivational and behavioural outcomes were investigated using univariate analysis. Also, a post hoc test using Tukey's HSD comparisons was applied to examine the potential causes of differences among groups with different perceptions of teacher factors. The normality distribution for each variable was normal to mild non-normal based on the criteria presented by Enders (2001). The missing case analysis showed that the cases with missing values were under 5%, not requiring missing pattern analysis (Tabachnick & Fidell, 2001). Several outlier cases were detected but no multivariate outlier cases or singularity were detected. Therefore, no transformations were applied.

Results

Preliminary analysis

Means, standard deviations, and intercorrelations among the given variables were presented in Table 1. Preliminary analysis showed that students, in general, responded highly positively to perceived teacher factors, belongingness, enjoyment, efficacy, and engagement. The results indicated significant

Table 1. Descriptive statistics and intercorrelations among variables

Variables	M	SD	1	2	3	4	5	6	7	8	9	10
1. Gender	.49	.50	—									
2. Grade level	—	—	—	—								
3. PTAS	4.46	.52	.26**	.24**	—							
4. PTMGO	4.54	.55	.16*	.25**	.40***	—						
5. Belonging	4.04	.81	.10	.09	.62***	.39***	—					
6. Enjoyment	4.57	.56	.22**	.11	.60***	.40***	.43***	—				
7. Anxiety	2.35	.91	-.10	-.16	-.21**	-.08	-.14	-.40***	—			
8. Self-efficacy	4.41	.51	.27***	.03	.42***	.28***	.42***	.56***	-.38***	—		
9. Engagement	4.38	.51	.28***	.03	.42***	.29***	.36***	.51***	-.50***	.65***	—	
10. Science Grade	3.67	1.23	.16*	-.02	.32***	.23***	.36***	.36***	-.39***	.55***	.51***	—

Note: PTAS: Perceived Teacher Affective Support; PTMGO: Perceived Teacher Mastery Goal Orientation
 N = 138 (Code for gender: male = 0, female = 1; code for grade level: fourth grade: 0; fifth grade: 1)

Key: ~ **p < .05, ** p < .01, ***p < .001.

associations between gender and several variables including PTAS, PTMGO, enjoyment, efficacy, engagement and science grade, favouring girls. Grade level only related to PTAS and PTMGO, favouring older students. Students' science grade related to all given variables, except the grade level.

Hierarchical regression analysis

In the hierarchical regression analysis presented in Table 2, gender and grade variables were entered in Step 1 as the control variables. The PTAS, PTMGO variables and their interaction term were entered in Step 2, sense of belonging was entered in Step 3, academic emotions were entered in Step 4, and motivational variables were entered in Step 5. In Step 1, gender and grade variables alone did not account for a significant amount of variance in students' science achievement scores [$\Delta F(2, 135) = 1.75, p = .18$]. In Step 2, PTAS, PTMGO, and the interaction term explained an additional 13% of variance in students' science scores [$\Delta F(3, 132) = 6.56, p < .001$]. The relationship between PTAS and achievement was significantly positive ($\beta = .32, p = .001$) but no statistically significant relationship was detected between PTMGO and science achievement ($\beta = .18, p = .06$). The effect of the interaction term was also not significant ($\beta = .15, p = .10$).

In Step 3, belonging did not account for a statistically significant amount of variance in science achievement ($\beta = .21, p = .06$). This model explained only 2% of an additional variance in achievement [$\Delta F(1, 131) = 3.74, p = .06$]. In step 4, emotional variables, academic enjoyment and academic anxiety were explained an additional 12% of variance in science achievement [$\Delta F(2, 129) = 10.99, p < .001$]. The relation between academic anxiety and science achievement was significantly negative ($\beta = -.33, p < .001$), but no relation was detected between academic enjoyment and science achievement ($\beta = .07, p = .48$).

In the final step, two motivational variables, academic self-efficacy and behavioural engagement explained 10% of an additional variance in science achievement of elementary school students [$\Delta F(2, 127) = 10.14, p < .001$]. Academic self-efficacy, in particular, was significantly positively related to students' science achievement ($\beta = .31, p < .001$), but no statistically significant relation was detected between behavioural engagement and academic achievement ($\beta = .18, p = .09$).

Table 2. Hierarchical regression analysis examining the effects of given variables for predicting science achievement

Variables	Step 1	Step 2	Step 3	Step 4	Step 5	R ²	ΔR ²	ΔF	p
Step 1						.03		1.75	.18
Gender	.16	.08	.09	.07	-.01				
Grade	-.02	-.14	-.12	-.16	-.11				
Step 2						.15	.13	6.56	< .001
PTAS		.32**	.19	.10	.07				
PTMGO		.18	.13	.13	.09				
PTAS x PTMGO		.15	.12	.13	.09				
Step 3						.18	.02	3.74	.06
Belonging			.21	.19	.11				
Step 4						.30	.12	10.99	< .001
Enjoyment				.07	-.07				
Anxiety				-.33***	-.20*				
Step 5						.39	.10	10.14	< .001
Efficacy					.31**				
Engagement					.18				

Note. Standardized regression coefficients reported. N =138, *p < .05, ** p < .01, ***p < .001.

PTAS: Perceived Teacher Affective Support, PTMGO: Perceived Teacher Mastery Goal Orientation

Students' outcomes based on different levels of perceived teacher factors

To determine whether different levels of perceived teacher factors relate to changes in students' perceptions of sense of belonging, academic emotions, academic self-efficacy, behavioural engagement, and science achievement outcomes, a univariate analysis of variance was performed. Before the data analysis, the independent variables, perceived teacher factors, were z-standardized to control the potential multicollinearity between variables. Students who reported PTAS and PTMGO components above .50 in terms of z score were considered as high in PTAS and high in PTMGO while students reporting those variables below .50 were considered as low in PTAS and low in PTMGO. Two students with missing information were excluded from the further analysis.

As seen in Table 3, students' sense of belonging, academic enjoyment, academic anxiety, academic self-efficacy, behavioural engagement and science grades differed significantly among given groups. In order to explore the potential causes of significant differences among groups, a post hoc analysis using Tukey's HSD comparisons was applied. Findings revealed that the differences among groups were primarily caused by the noticeable discrepancy between Low PTAS/Low PTMGO and High PTAS/High PTMGO groups.

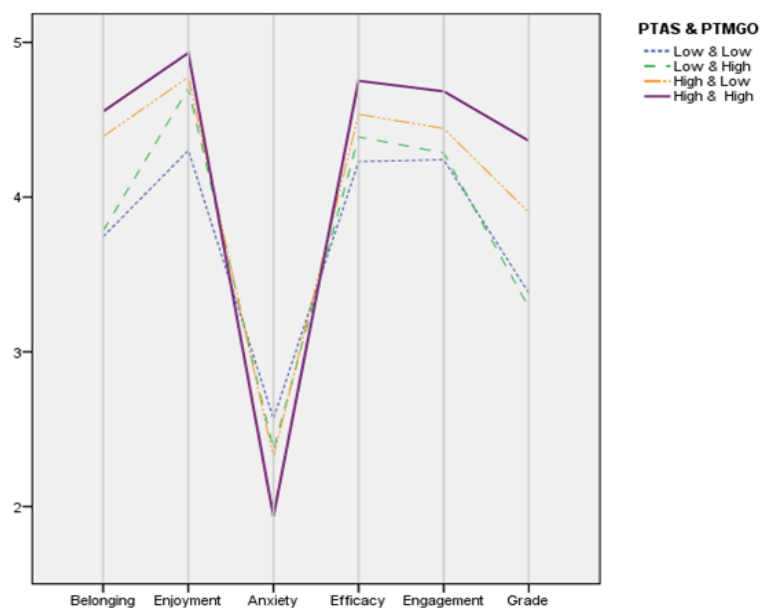
Specifically, the findings showed that students in High PTAS/High PTMGO group reported the highest levels of sense of belonging, academic enjoyment, academic self-efficacy and behavioural engagement, the lowest levels of academic anxiety and received the highest science grades among all four groups. On the other hand, students in Low PTAS/Low PTMGO group reported the lowest levels of sense of belonging, academic enjoyment, academic self-efficacy, behavioural engagement and the highest levels of academic anxiety compared to their peers in other three groups.

Table 3. The effects of different levels of PTAS and PTMGO on students' given outcomes

Measures	Low PTAS/ Low PTMGO (n = 60)		Low PTAS/ High PTMGO (n = 21)		High PTAS/ Low PTMGO (n = 22)		High PTAS/ High PTMGO (n = 33)		Univariate Analysis		
	M	SD	M	SD	M	SD	M	SD	F	p	η^2
Belonging	3.71 _a	0.75	3.78 _a	1.04	4.44 _b	0.63	4.55 _b	0.43	12.82	< .001	.23
Enjoyment	4.27 _a	0.65	4.70 _b	0.38	4.77 _b	0.27	4.93 _b	0.16	16.04	< .001	.27
Anxiety	2.58 _a	0.79	2.37 _{ab}	0.99	2.38 _{ab}	1.13	1.94 _b	0.80	3.67	.01	.08
Efficacy	4.21 _a	0.51	4.39 _{ab}	0.59	4.55 _{bc}	0.39	4.75 _c	0.24	10.65	< .001	.20
Engagement	4.23 _a	0.52	4.29 _a	0.51	4.44 _{ab}	0.48	4.68 _b	0.32	7.03	< .001	.14
Grade	3.38 _a	1.37	3.29 _a	1.31	3.90 _{ab}	1.02	4.36 _b	0.74	5.92	.001	.12

Note. PTAS: Perceived Teacher Affective Support, PTMGO: Perceived Teacher Mastery Goal Orientation. Means in the same row that do not share the same subscript differ significantly at $p < .05$ in Tukey's HSD comparison.

As presented in Table 3, based on Tukey's HSD comparisons, the only statistically significant difference between the first and the second groups, Low PTAS/Low PTMGO vs. Low PTAS/High PTMGO, was related to academic enjoyment. The results showed that students' increased perception of teacher mastery goal orientation resulted in an increase in their academic enjoyment in science. The only statistically significant difference between the second and the third groups, Low PTAS/High PTMGO vs. High PTAS/Low PTMGO was related to students' sense of belongingness, favouring High PTAS/Low PTMGO group. Specifically, students' perceiving their teachers more mastery oriented but less affectively supportive reported significantly lower sense of belonging compared to students perceiving their teachers more affectively supportive but less mastery oriented. Science achievement outcomes of students in High PTAS/Low PTMGO group were also noticeably higher than the first two groups even though it was not statistically significant.

**Figure 1.** Profiling of outcome variables based on the different levels of PTAS and PTMGO

Students grouped in High PTAS/Low PTMGO and High PTAS/High PTGMO did not differ significantly for any given variable. On the other hand, students grouped in Low PTAS/High PTMGO vs. students in High PTAS/High PTMGO were differed significantly in terms of sense of belonging, academic self-efficacy, behavioural engagement and science achievement, favouring students in High PTAS/High PTMGO group. This finding reveals the importance of PTAS for elementary school students. As presented in Figure 1, however, students grouped in High PTAS/High PTMGO were superior in all positive outcomes, reported the lowest anxiety, and received the highest grades in science.

Discussion

The purpose of the current study was to investigate the roles of perceived teacher factors, sense of belonging, academic emotions, academic self-efficacy and behavioural engagement on students' science achievement in elementary school science classrooms in Turkey. The potential relations of different levels of perceived teacher factors with given outcomes were examined as well. The overall findings showed that the three factors that significantly related to students' science achievement controlling for gender and grade level were PTAS, academic self-efficacy, and academic anxiety. Students who reported High PTAS/High PTMGO also reported the highest levels of sense of belonging, academic enjoyment, academic self-efficacy, and behavioural engagement among four groups. Students in this group also reported the lowest levels of academic anxiety and received the highest science grades compared to students in other groups. More detailed discussions of these findings are presented below.

In the present study, based on bivariate relations, girls were found to be more inclined to perceive their teachers affectively supportive and mastery oriented compared to boys. Girls reported significantly higher behavioural engagement in class, greater academic enjoyment and academic self-efficacy; and received significantly higher grades in science in comparison to boys. According to the bivariate correlations, fifth-graders perceived their teachers more affectively supportive and mastery oriented compared to fourth-graders. The bivariate associations also revealed that students' science achievement significantly positively linked to sense of belonging, academic enjoyment, academic self-efficacy and behavioural engagement. As predicted, the bivariate relation between science achievement and academic anxiety was significantly negative. The strongest link among variables was between academic self-efficacy and behavioural engagement.

The hierarchical regression analysis showed insignificant gender or grade level effect on science achievement. Regression analysis revealed that PTAS and academic self-efficacy were significantly positively; and academic anxiety was significantly negatively associated with students' science achievement, controlling for gender and grade level. These findings corroborate with previous research (Gherasim et al. 2013; Lumby, 2011; Phan, 2012; Shen & Pedulla, 2000). PTMGO, sense of belonging, academic enjoyment, and behavioural engagement were not statistically significantly related to students' science achievement. The interaction effect of PTAS and PTMGO was also insignificant. These findings were unexpected. The examination of the bidirectional relations revealed that all these given factors were significantly positively related to students' achievement in science. The unpredicted results in the regression analysis might be related to the potential suppression effects of PTAS, self-efficacy, and anxiety on other variables in the investigation. The bivariate associations showed that especially PTAS powerfully related to sense of belonging and academic enjoyment. This finding suggests that belonging and enjoyment share some significant amount of variance with PTAS. Given that sense of belonging and academic enjoyment entered into the hierarchical regression analysis after PTAS, the predictive powers of sense of belonging and academic enjoyment on students' science grades may have been significantly reduced due to the presence of PTAS.

An insignificant association between PTMGO and achievement was especially unexpected due to the positive reports in the related research conducted in the field (e.g., Moreira et al., 2013; Ramnarian,

2013; Roeser et al., 1996). In a recent study, Moreira et al. (2013) reported that both perceived teacher support and teacher mastery goal orientation are significant predictors of students' academic performance in Portuguese secondary school classrooms. The current results, however, reveal that in the presence of PTAS, the sole predictive power of PTMGO on students' achievement outcomes diminishes. Tukey's HSD comparisons suggest that the major potential reason preventing PTMGO to be a predictor of science achievement might be related to the sole power of PTAS on achievement. The examination of the different levels of PTAS and PTMGO, however, suggests that there might actually be a significant strengthening link between these variables.

The univariate and post hoc analyses showed that the different levels of PTAS and PTMGO significantly related to students' sense of belonging, academic enjoyment, academic anxiety, academic self-efficacy, behavioural engagement, and academic achievement in science classrooms. High PTAS/High PTMGO together, provided the most optimal emotional and motivational outcomes for elementary school students. Specifically, students perceiving their teachers both affectively supportive and mastery goal oriented felt more belong, joyful, self-efficacious; became more engaged in learning activities; experienced less anxiety; and received higher grades in science classrooms compared to other students. These results were consistent with previous research, especially in terms of emotional outcomes (Barkoukis et al., 2012; Patrick et al., 2003). These findings also support the theoretical assumption of Midgley and Edelin (1998) that teacher affective behaviours and teacher mastery goal orientation must present together in learning environments to promote positive student outcomes in learning processes. Midgley and Edelin (1998) made their suggestions for middle school teachers but the current study showed that the similar expectations are vital for elementary school teachers as well.

Tukey's HSD comparisons between the first and the second groups (Low PTAS/Low PTMGO vs. Low PTAS/High PTMGO) showed that students' increased perception of teacher mastery goal orientation resulted in an increase in their academic enjoyment in science. The comparisons of the second and the third groups (Low PTAS/High PTMGO vs. High PTAS/Low PTMGO) revealed that students' increased perception of teacher affective support resulted in an increase in their sense of belongingness. Comparing this outcome with the fourth group's (High PTAS/High PTMGO) belonging outcome suggests a potential *moderation* effect of PTAS between PTMGO and sense of belonging. In other words, students perceiving their teachers mastery goal oriented may feel more belong in class *depending on the level of perceived teacher affective support*.

The overall findings, however, suggest that PTAS might be one step ahead of PTMGO on predicting students' positive outcomes. The results showed that there was no statistically significant difference between students' outcomes grouped in the third and the fourth groups (High PTAS/Low PTMGO vs. High PTAS/High PTMGO); but four outcomes (sense of belonging, academic self-efficacy, behavioural engagement, and science achievement) were significantly differed between the second and the fourth groups (Low PTAS/High PTMGO vs. High PTAS/High PTMGO), in favour of the fourth group. These findings show the necessity of considering PTAS in the examination of PTMGO. More studies conducted in different contexts with the participation of students in different developmental levels are needed to validate these findings.

It is important to note that the results of the current research cannot reduce the importance of teacher mastery goal orientation. In their research, Skaalvik and Skaalvik (2013) made the following comment on promoting mastery goal orientation together with emotional support:

...teachers should be aware that students who lack motivation to do schoolwork and show little effort, may interpret emotional support as an acceptance of lack of effort. It is therefore important that social support includes encouragement of effort, as well as a focus on improvement. (p. 12)

The overall findings of the current research suggest that teacher affective behaviours accompanied with mastery goal orientation improve positive psychological climate and enhance students' emotional, motivational and academic functioning in science classrooms in elementary schools. According to social cognitive perspective, students observe, imitate and internalize teacher behaviours (Bandura, 1997). Therefore, teachers need to build affective environments by modeling care, respect and concern for others, listening, encouragement and high expectations. They also need to emphasize mastery goal orientation through encouraging challenge, effort, participation, understanding, and collaboration. Being affectionate and mastery goal oriented not only positively influence students' outcomes but also are beneficial for teachers' own vocational proficiency. A recent research, for instance, shows that mastery oriented teachers demonstrate high interest in teaching and low burnout rates in their profession (Retelsdorf, Butler, Streblov, & Schiefele, 2010).

Some of the limitations of the current study need to be recognized. The correlational analyses used in the study cannot suggest causality between given variables. Therefore, experimental studies are needed to understand the pure effect of the perceived teacher factors on given variables. Also, the limited sample size used in the present study may have obscured the appearance of potentially statistically significant effects of some independent variables on science achievement. Therefore, similar studies using larger sample sizes are also needed.

The present research needs to be elaborated further. For example, students' perceptions of teacher behaviours and their responses to these behaviours may show changes based on their gender (Skaalvik & Skaalvik, 2013). Gender effect may also present for teachers. Rubie-Davies, Flint and McDonald (2012) reported that male teachers have tendency to be less mastery and more performance goal oriented compared to their female colleagues. Therefore, the potential roles of student and teacher gender effects need to be investigated using a larger sample sizes.

In future studies, the potential bidirectional relations need to be explored as well. For example, in the current study, it was found that students perceiving their teachers as affectively supportive and mastery oriented received the highest grades in science class. But, this finding cannot suggest causality. Investigations should focus on whether students' perceptions differ based on their academic performances in class. Another related point which deserves closer look is that teachers may behave differently to their students based on students' achievement outcomes. There is no certain knowledge related to whether obtained outcomes stimulate perceptions or perceptions stimulate outcomes. It is highly possible that both affect each other reciprocally.

In terms of the reciprocal determinism principle of social cognitive theory (Bandura, 1997), which emphasizes a continuous interaction between person, behaviour and environment, it is highly likely that a reversing flow exists from achievement, efficacy to emotions and teacher variables, which needs to be examined through longitudinal studies. By adopting social cognitive perspective, the starting point in the current study was environmental perceptions, given that emotional, motivational, and behavioural reactions are socially-rooted (Bandura, 1986). Environmental perceptions are built on previous experiences which strongly determine self-beliefs and behaviours.

In the present research, using Bandura's (1997) perception that psychological arousal is one of the sources of self-efficacy and Carroll Izard's (1991) view that emotions trigger cognition and behaviour, the flow of analyses was from emotional variables to self-efficacy, engagement and achievement. If the study was longitudinal, the reverse flow, starting from achievement to the environmental factors should have been examined. Understanding the true nature of relations will surely be possible through more longitudinal studies.

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