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The influence of teachers' need-support profiles on students' collective engagement in science classes: An observational study based on self-determination theory

Münevver Subaşı Çolak[1], Gülşen Koçak[2], Yasemin Taş[3], Sündüs Yerdelen[4]

[1]Hatay Mustafa Kemal University, 0000-0001-6777-6995
[2]Atatürk University, 0000-0001-7048-7545
[3]Atatürk University, 0000-0002-3553-8711
[4]Kafkas University, 0000-0002-2100-0822

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The influence of teachers' need-support profiles on students' collective engagement in science classes: An observational study based on self-determination theory

Münevver Subaşı Çolak[1*], Gülşen Koçak[2], Yasemin Taş[2], Sündüs Yerdelen[3]
[1]Hatay Mustafa Kemal University
[2]Atatürk Univeristy
[3]Kafkas University

Abstract

This study aims to reveal the need-support profiles of science teachers by using three variables (teachers' autonomy support, involvement, and structure support), as well as the role of the teachers with such profiles in students' collective engagement. Within the scope of the study, first of all, the observation form developed by Reeve, Jang, Carrell, Jeon, and Barch (2004) was adapted into Turkish. Then, 41 science lessons taught by different teachers were observed using the form during a class hour. Descriptive statistics, cluster analysis, and independent samples t-tests were performed using IBM SPSS Statistics 20 to analyze the data. The cluster analysis showed that teachers in most classes (n = 35) were highly need-supportive, while a few teachers (n = 6) were moderately need-supportive. The independent samples t-test analysis demonstrated that the collective engagement of the students in the classrooms where the teachers were highly need-supportive was more than those of the students in the classrooms where the teachers were moderately need-supportive. Students' collective engagement varied according to the teachers' need-supportive profiles. In other words, it can be assumed that teacher behaviors play a crucial role in students' collective engagement.

Keywords: Teachers' autonomy support, Teachers' involvement, Teachers' structure support, Students' collective engagement, Science education.

Introduction

With its key role in academic achievement, motivation, and learning, student engagement is a controversial issue among researchers and educators, as well as politicians (Kahu, 2013; Thijs & Verkuyten, 2009; Xu, Chen & Chen, 2020), and has been increasingly attracting the attention in recent years (e.g., Bond, Buntins, Bedenlier, Zawacki-Richter & Kerres, 2020; Guzey & Li, 2022; Raes et al., 2020, Wekullo, 2019; Zepke, 2018). In the simplest terms, student engagement could be defined as the active and efficient participation of students in routine learning activities in the classroom (Reeve, Cheon & Jang, 2020; Skinner, Kindermann, Connell & Wellborn, 2009).

In this respect, self-determination theory (SDT) suggests a clear relationship between the characteristics of the social environment in which individuals exist and their motivation and engagement in the lesson (Reeve, 2012). Student engagement can be influenced by several factors, including teachers, parents, and peers, concerning their support in a social setting. Among these factors, teachers' support is regarded as one of the most important factors (Lam et al., 2012; Lietaert, Roorda, Laevers, Verschueren & De Fraine, 2015). In this regard, most theorists and educators agree that teacher-created classroom environments could profoundly impact students' academic motivation, engagement, and achievement (Patall et al., 2013). The present study follows SDT's perspective on teachers' motivating or instructional style (Ryan & Deci, 2000; Reeve, Jang, Carrell, Jeon & Barch, 2004). Accordingly, the prominent dimensions of teachers' support can be listed as follows: Teachers' autonomy support for their students, teachers' structure support, and their involvement in the classroom environment. In other words, teachers are expected to *support their students' autonomy* by giving them the freedom to make their own choices, support the *structure* by setting clear rules, and ensure their *involvement* by caring for and paying attention to students (Roorda, Koomen, Spilt & Oort, 2011).

* Corresponding Author: *Münevver Subaşı Çolak, munevversubasi@gmail.com*

Indeed, there is empirical evidence that teachers' motivating style is related to students' basic psychological needs, predicting students' engagement (e.g., Jang, Kim & Reeve, 2012; 2016). In SDT, there are three basic psychological needs: autonomy, competence, and relatedness. Autonomy is defined as making choices and acting independently; competence is related to the achievement of the desired result with appropriate responses to tasks, while relatedness refers to the need for mutual respect and interest (Deci & Ryan, 2000; Ryan & Deci, 2020). Students' autonomy needs can be satisfied by the teacher's autonomy support motivating style, relatedness can be satisfied by the teacher's involvement, and competence needs can be satisfied by teachers' structure support (Hornstra, Stroet & Weijers, 2021). For instance, the more teacher involvement (that is, the teacher relates to students, makes time, and expresses love, communicates with the student), the better the feedback will be, and this will increase the participation rate of the students (Valdes, Denner, Dickson & Laursen, 2021; Vollet, Kindermann & Skinner 2017).

However, the predictive power of such teacher behaviors with respect to student engagement clearly differs in various studies. For example, Appleton, Christenson, and Furlong (2008) reported that autonomy support and involvement were directly related to student engagement rather than structure, and that structure and autonomy support, or enabling the involvement accompanied by autonomy support, was associated with higher behavioral engagement. Tucker et al. (2002) found that teacher involvement accounts for student engagement more than other dimensions of teachers' need-support. Jang, Reeve, and Deci (2010), on the other hand, discussed students' individual and collective engagement, which is less common in the literature. Their study considers the teachers' autonomy support and structure support as predictors of the students' collective engagement. They also aimed to examine the extent to which students' collective engagement could be predicted concerning science teachers' autonomy support, involvement, and structure support.

Students' collective engagement

Engagement is the energy and effort students employ within their learning community, which can be observed via cognitive or affective indicators (Bond et al., 2020). Student engagement can be defined as the mental state students experience while learning, representing the intersection of emotion and cognition (Barkley & Major, 2020). The USA National Survey of Student Engagement (NSSE) has designated five elements as indicators of engagement: the level of academic challenge, active and collaborative learning, student-faculty interaction, enriching educational experiences, and supportive campus environment (Coates, 2005).

Research has shown that student engagement is generally considered in four dimensions, cognitive, behavioral, emotional, and agentic engagement (Reeve and Tseng, 2011). Cognitive engagement refers to the amounts and types of strategies used by students (Walker, Greene & Mansell, 2006). With cognitive engagement, students can use deeper and more complex learning strategies rather than superficial strategies (Reeve, 2013; Yuan & Kim, 2018). Behavioral engagement denotes students' engagement in learning activities through intense effort and concentration (Skinner & Belmont, 1993). Emotional engagement implies students' interest and desire to learn, as well as positive and negative emotions such as pleasure, curiosity, anxiety, or boredom (Reeve & Tseng, 2011; Skinner & Belmont, 1993). Finally, agentic engagement is defined as students' constructive contributions to the flow of the education they receive, such as asking questions during the lesson or informing the teacher of their preferences and ideas (Reeve & Tseng, 2011). In other words, agentic engagement is a way through which students can improve their learning, development, and performance (Reeve & Shin, 2020). In a general sense, all these engagements are interrelated in such a way that when one engagement type is high, the others are also likely to be high (e.g., Hıdıroğlu, 2014; Reeve, 2013; Reeve & Tseng, 2011). For example, students with high levels of behavioral engagement may show significant cognitive or emotional engagement (Sinatra, Heddy & Lombardi, 2015).

Students' collective engagement indicates that a class community collectively negotiates discipline-related ideas, terms, and norms (Ryu & Lombardi, 2015). In collective engagement, all aspects of student engagement are handled collectively. Student's behaviors in classrooms where there is collective engagement include those such as exhibiting a pleasant and entertaining attitude towards the lesson, asking questions and discussing, showing active and quick behavior, and acting persistently without giving up in the face of challenges (Reeve, Jang, Carrell, Jeon & Barch, 2004). Reeve et al. (2004) measured students' collective engagement through an observation form. This form combines different aspects of engagement, such as attention, effort, verbal engagement, persistence, and positive attitude (Cents-Boonstra, Lichtwarck-Aschoff, Denessen, Aelterman & Haerens, 2021).

For instance, one of the items on the observation form addresses whether students give up easily by decreasing effort over time or persist by increasing effort over time during the challenge. Another example of item taps is whether the students are verbally silent or verbally participating by talking, asking questions, or discussing (Reeve

et al., 2004). As it is based on a strong theoretical conceptualization of engagement (Wellborn, 1991), it is easy to use to rate student behaviors in the classroom, and it does not rely on student perceptions gathered by self-report measures; this observation form has been preferred to measure student engagement in several studies (e.g., Cents- Boonstra et al., 2021; Jang et al., 2010; Reeve & Jang, 2006), In the present study, teachers' need support is taken into account as an important factor affecting students' collective engagement.

Teachers' need support

The SDT's fundamental psychological needs consist of competence, relatedness, and autonomy (Deci & Ryan, 2000; Ryan & Deci, 2020). It often appears that teachers must adopt a teaching style that supports these three needs. The teachers' need supports comprise teachers' autonomy support, which is related to supporting the students' need for autonomy; teachers' involvement, which refers to supporting the students' need for relatedness; and teachers' structure support, which represents the support provided for the sake of students' need for competence (Hornstra, Stroet & Weijers, 2021).

In science education, students academically benefit when they perceive their teacher as implementing need support (e.g., Beghetto, 2007; Burns, Martin & Collie, 2019; Furtak & Kunter, 2012). Perceived need-supportive teaching has been effective in science education for increasing students' motivation, participation, and achievement in science (Burns, Martin, Collie & Mainhard, 2021; Watt, Bucich & Dacosta, 2019).

Teachers' autonomy support

The first variable related to teachers' support addressed in this study is teachers' autonomy support, a concept that refers to the role that an individual in a position of authority takes others' perspectives, considers their emotions, and provides the opportunity for appropriate choices by minimizing pressure (Zhou, Ma & Deci, 2009). Teachers' autonomy support refers to the perception that an individual's views are supported and approved by a teacher (Li, Gao & Sha, 2020). Put differently, when teachers support autonomy, they pay attention to students' views and offer them options (Li et al., 2020; Patall et al., 2013). In addition, teachers who provide autonomy support are likely to be aware of, nurture, and develop students' interests as well as their needs and preferences by taking their perspectives and offering interesting activities to students by giving them appropriately challenging tasks and emphasizing clear learning goals (Jang et al., 2010; Reeve, 2009). Thus, a teaching style that supports autonomy can satisfy students' basic psychological needs for autonomy, competence, and relatedness (Deci & Ryan, 2000; Haerens, Aelterman, Vansteenkiste, Soenens & Van Petegem, 2015).

The benefits of teachers' autonomy support in science classes have also been documented by previous studies. For instance, teacher's autonomy support in science lessons increases students' problem-solving (Boggiano, Flink, Shields, Seelbach & Barrett, 1993; Kocoglu & Kanadlı, 2019) and critical thinking skills (Kocoglu & Kanadlı, 2019). Teachers' autonomy support enables students to make their own choices, make decisions, and take on learning responsibilities in science lessons (Akçil & Oğuz, 2015; Oğuz, 2013). Autonomy support from science teachers is positively related to students' autonomous motivation, self-efficacy, and achievement in science over time (Jungert & Koestner, 2015).

Reeve (2009) listed three conditions for supporting autonomy as follows: (i) adopting the students' perspective; (ii) welcoming students' thoughts, feelings, and behaviors; and (iii) supporting students' motivational development and capacity for autonomous self-regulation. In contrast, when autonomy support is not provided, a controlling authority uses pressure tactics to make students think, feel, or behave in the way the teacher suggests, thereby overrunning students' perspectives and pushing them to behave in certain ways through coercive or attention-taking techniques that include punishments (Reeve, 2009; Zhou et al., 2009). With this controlling authority, the quality of students' engagement in the course also decreases. Consequently, students will end up having a superficial quality engagement by pseudo-engaging in classes, as they may feel that it is risky to resist the academic pressures of highly controlling teachers. The fact that students study only the subjects required by their teachers indicates that this engagement remains limited and superficial (Assor, Kaplan, Kanat-Maymon & Roth, 2005).

Teachers' involvement

Teachers who prioritize involvement spend time with students to establish positive relationships, express their care, and share their needs and feelings (Archambault et al., 2020). Involved teachers can establish close relationships with students and give them adequate feedback. Through involvement with acts – such as showing students interest and affection, adapting to their needs, and providing emotional support – teachers can also meet

the student's needs for relatedness, which is one of the basic psychological needs (Hornstra et al., 2021). If students' needs are met with poor guidance and little involvement, their progress and achievement in schoolwork may become uncertain (Stornes, Bru & Idsoe, 2008). Some studies have reported that the higher the students perceive autonomy and structure support, the higher they perceive teacher involvement (e.g., Hornstra et al., 2021). Teachers' involvement encourages student engagement and is strongly linked to emotional engagement (Hospel & Galand, 2013; Sierens, Vansteenkiste, Goossens, Soenens & Dochy, 2009; Skinner & Belmont, 1993).

Teachers' structure support

The other teacher support variable discussed in this study is the structure that a teacher provides in the classroom. The structure refers to conveying clear expectations for the kind of student behavior by providing clear instructions, comprehensive assistance, and feedback regarding their proficiency (Lietaert et al., 2015; Sierens et al., 2009). The structure created by teachers in the classroom environment is the one in which they communicate with the students clearly and understandably to convey what they expect from them, exhibit behaviors in conformity with what is expected of them, and give them positive feedback (Connell & Wellborn, 1991). Consequently, such a structure will limit students' behavior and ensure its continuation (Sierens et al., 2009). Also, the structure in the classroom environment includes a clear and understandable layout, definite plans and objectives, explicitly stated procedures, and fast-paced tasks. In this manner, students will know better how to achieve goals since the structure provided include helping students participate in a task (Sierens et al., 2009; Skinner & Belmont, 1993).

The relationship between teachers' behaviour and students' collective engagement

Many factors influence student engagement (Van Uden, Ritzen & Pieters, 2014). The factors affecting students' engagement in the course generally include peers, teachers' support, classroom structure, autonomy support, and task characteristics (e.g., Fredricks, Blumenfeld & Paris, 2004; Yuan & Kim, 2018). Students' engagement with the lesson is linked to the teachers' behavior (Tas, 2016), and teacher behavior is central to ensuring engagement (Kuh, Kinzie, Buckley, Bridges & Hayek, 2006; Zepke, Leach & Butler, 2014). Research has shown that the studies in the literature generally support the idea that teacher behavior is positively related to student engagement (e.g., Jang et al., 2010; Kiefer, Alley & Ellerbrock, 2015; Lam et al., 2012; Marks, 2000; Martin & Collie, 2019; Skinner, Furrer, Marchand & Kindermann, 2008; Skinner & Belmont, 1993) as well as those that only deal with the relationship between the teachers' autonomy support from among the types of teachers' support and the engagement of the students to the course (e.g., Jang, Kim & Reeve, 2016; Li et al., 2020; Reeve et al., 2004). For instance, Benlahcene, Awang-Hashim and Kaur (2020) found that teachers' autonomy support was positively associated with classroom engagement in their experimental study with undergraduate students (n = 266) at a large public university in northern Malaysia. In another study, Jang et al. (2010) reported that, in addition to the autonomy support given to the students in years 9–11, structure support accounted for students' collective behavioral engagement. Their results showed that teachers' autonomy support and structure support were positively related to the students' behavioral engagement. Similarly, Uçar and Sungur (2017) examined the relationship between 7th-grade students (n = 744) perceptions of classroom environment, self-efficacy beliefs, and engagement in the science course. The researchers revealed that teachers' providing more autonomy support accounted for students' engagement in the lesson in a positive sense.

In this study: (1) the level of autonomy support, involvement, and structure support provided by teachers will be examined; (2) teachers will be profiled according to the level of exhibiting such teacher behaviors; and (3) it will be investigated whether or not there is a difference between the collective engagements of students in classes concerning different teacher profiles. The structure support, involvement, and autonomy support provided by science teachers in their classrooms and the levels of students' collective engagement were identified through observations. Generally, previous studies have measured these variables given student perceptions (e.g., Hornstra et al., 2021; Stornes et al., 2008). However, one of the limitations of this method is the uncertainty of whether the students gave candid answers. It has been recommended that observations be used to overcome this limitation (Jang et al., 2016). For this reason, the original aspect of this study is that it determines teacher behaviors and student engagement levels by making observations. Class profiles will be identified according to teachers' behaviors (autonomy support, involvement and structure), and the collective engagement levels of students in classes with different profiles will be compared.

Method

Design

This is a cross-sectional quantitative study aiming to compare the collective engagement levels of students in classes with different profiles shaped by teacher behavior. To conduct the study, the researchers decided to focus on science lessons; hitherto, they determined certain classrooms taught by different science teachers in different schools with whom they attended the classes for the study. It attempted to explore the extent of autonomy support, involvement, and structure provided by science teachers while teaching and the extent of students' collective engagement by using a structured observation form.

Sample

The study sample was selected according to the convenience sampling method. The participants comprised 41 science teachers in nine middle schools located in one of the largest provinces in eastern Turkey and 1018 middle school students. Of all the teachers, 27 were female, while 14 were male. Approximately 59% of the teachers were science teachers; 17% were physics, chemistry, or biology teachers; 17% of all the teachers had graduated from the physics, chemistry, or biology departments of science faculties; 5% from integrated physics-chemistry-biology teachers, and 2% from institutes of education. Teachers' professional experience ranged from 1 to 35 years, with an average of 16.10 (SD = 9.18) years, and their weekly teaching hours varied between 12 and 30, with an average of 23.64 (SD = 3.78) hours.

Of all the study participants, 33.8% were in Year 6, 36.4% in Year 7, and 29.8% in Year 8. Sixth graders were in the age range of 11 and 12 years, seventh graders of 12 and 13 years, and eighth graders of 13 and 14 years.

Data collection tool

We used an observation form developed by Reeve, Jang, Carrell, Jeon and Barch (2004). The observation form included four sub-dimensions: teachers' autonomy support (4 items), teachers' involvement (4 items), teachers' structure support (5 items), and students' collective engagement (5 items). Table 1 presents the example items given in the sub-dimensions. With its bipolar style, the observation form includes negative statements (1 point) on the left and positive statements (7 points) on the right. The observation form was adapted into Turkish by the researchers. First translated into Turkish, the form was then assessed by two field experts regarding clarity and cultural appropriateness and arranged in line with the recommendations. Afterward, the form was sent to a language specialist together with its original form so that it would be examined in terms of language suitability, as a result of which the Turkish form was edited and given its final form. The Turkish version of the observation form is given in the Appendix. Considering the reliability analyses made on the scores taken from the form as a result of classroom observations, the Cronbach's alpha coefficient for the sub-dimensions was calculated as 0.73 for teachers' autonomy support, 0.81 for teachers' involvement, 0.91 for teachers' structure support, and 0.97 for students' collective engagement.

Table 1. Sub-Dimensions of the observation form and sample items

Teacher's autonomy support	**Controlling language** • Controlling, coercive • Should, must, have to, got to • Pressuring, rigid, no nonsense	1	2	3	4	5	6	7	**Informational language** • Informational • Flexible • Not at all controlling
Teacher's involvement	**Seems cold, closed** • Business like • Does not enjoy time with Ss	1	2	3	4	5	6	7	**Seems warm, open** • Expresses, affection, caring • Does enjoys time with Ss
Teacher's structure	**Poor leadership** •Fails to show leadership • No plans, no goals	1	2	3	4	5	6	7	**Strong leadership** • Organized, leader, conductor • Clear plans, clear goals

Student's collective engagement	**Verbally silent** • Students don't talk, ask questions, discuss	1	2	3	4	5	6	7	**Verbally participating** • Students do talk, ask questions, discuss

Data collection process

The first and second authors collected the data by observing 41 science teachers and their students for one course hour. The observers observed teachers' autonomy-supportive, involvement, and structure-supportive behaviors and rated them considering illustrative descriptors in the observation sheet. On the other hand, students' collective engagement was rated by looking at the students' percentage displaying each behavior and their expression intensity, as suggested by Reeve et al. (2004). Thus, "a high score on an engagement indicator means that most or almost all of the students expressed the behavior, and when they did express it, they did so intensely" (Reeve et al., 2004, p. 157). In the first part of the process, two researchers were present in the same classroom at different spots and made observations together for 4 course hours. At the end of the observation process, the researchers compared the scores they gave in the observation form and calculated the agreement rate between them. The percentage of agreement between the researchers' scores was calculated using the formula "Reliability = [Number of Agreements / (Number of Agreements + Disagreements)] × 100" (Miles & Huberman, 1994). The agreement between the observation scores of the two researchers was found to be 78%. After achieving the required agreement percentage, the researchers continued their classroom observations separately. The variables of teachers' autonomy support, involvement and structure support, and the students' collective engagement were formed by taking the mean values of the scores, varying between 1 and 7, as given by the researchers to the items in each sub-dimension.

Data analysis

Descriptive statistics, cluster analysis, and independent samples t-tests were performed using IBM SPSS Statistics 20 to analyze the study's variables. In the descriptive statistics part of the data analysis process, the mean and standard deviation were calculated to determine the level of teachers' autonomy support, involvement, and structure support and students' engagement, whereas cluster analysis was employed to determine the teachers' behavior profiles. An independent samples t-test was used to determine whether or not there is a difference between the collective engagements of students in classes with different teacher profiles.

Results

Descriptive statistics

Descriptive statistics for the variables of the study are presented in Table 2. Compared to 4, the mid-point of the scale, all teacher variables and students' collective engagement have high mean values which ranged from 5.47 to 5.86.

Table 2. Descriptive statistics

	M	*SD*	Min-Max	Skewness	Kurtosis
Teacher autonomy support	5.74	.94	3.21-6.94	-1.30	1.07
Teacher involvement	5.72	1.13	2.75-7.00	-1.04	.67
Teacher structure support	5.86	1.02	2.83-7.00	-1.31	1.38
Students' collective engagement	5.47	1.36	2.20-7.00	-.87	-.09

Cluster analysis

A cluster analysis was conducted to determine the teachers' profiles in the observed science classes. The k-means cluster method was used by restricting the number of clusters to two, three, and four, respectively. The analysis with two clusters provided the most interpretable results. In the first cluster, teachers' autonomy, involvement, and structure were centered at 6.04, 6.05, and 6.17 points, while in the second cluster, they were centered at 4.00, 3.79, and 4.03 points, respectively. All three variables were found to significantly impact which cluster teachers were grouped into (Table 3). The first cluster (n = 35) involves teachers who have high autonomy support, involvement, and structure support, while the second cluster (n = 6) involves teachers, considering the mid-point (4) of the observation items, with relatively lower autonomy support, involvement, and structure support in science

class. Therefore, these 1st and 2nd clusters can be named high supportive and moderate supportive, respectively. Figure 1 shows the levels of variables in each cluster.

Table 3. Cluster centers and F values

	Cluster centers		F	p
	Cluster 1 High supportive	Cluster 2 Moderate supportive		
Autonomy support	6.04	4.00	58.561	.000
Involvement	6.05	3.79	40.685	.000
Structure support	6.17	4.03	49.641	.000

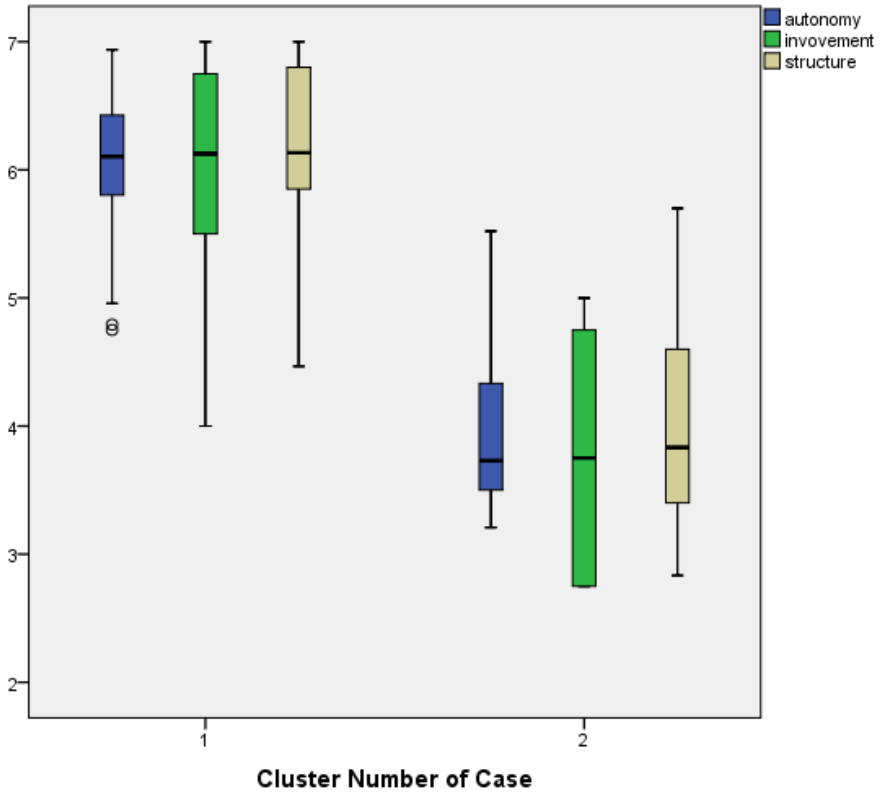

Figure 1. Levels of variables within clusters

Independent samples t-test

After obtaining two teacher profiles within observed classrooms, an independent samples t-test was performed to examine whether students' collective engagement differed depending on the teacher's supportive profile. Since the number of teachers within each cluster is different, the homogeneity of variance assumption was checked, and Levene's test showed that this assumption is not violated (F = 0.13, p = 0.91). Additionally, the normality test indicated the normal distribution of low supportive clusters even though they have a small number of observations (Shapiro-Wilk test statistic = 0.90, p = 0.40). Independent samples t-test showed that students in classes taught by teachers who have highly supportive teaching profiles have statistically significantly higher collaboration ($\bar{X}$ = 5.82, SD = 1.07, $t_{(39)} = 5.03, p < 0.05$) than students taught by moderate supportive teachers ($\bar{X} = 3.43, SD = 1.08$). The eta-squared value of 0.39 indicates a large effect size (Cohen, 1988). Table 4 presents the findings of the t-test for students' collective engagement.

Table 4. Results of independent samples t-test for student's collective engagement

	n	$\bar{X}$	*SD*	*t*	*df*	*p*
High supportive profile	35	5.82	1.07	5.03*	39	.000*
Low supportive profile	6	3.43	1.08			

*$p < .05$

Conclusion

This study aimed to reveal the class profiles according to the science teachers' behaviors and to compare the students' collective engagement in science with different teacher profiles. The teacher behaviors addressed in this study included teachers' autonomy support, involvement, and structure support, while students' collective engagements comprised their task engagements and work to influence the flow of classroom activities. Analysis of observation data indicated high levels of teachers' autonomy support, involvement, and structure support. Similarly, the students' collective engagement levels were also high.

According to the cluster analysis performed to specify science teachers' profiles, the appropriate number of clusters turned out to be. Most teachers (approximately 85%) were in the first cluster. The teachers' autonomy, structure support, and involvement seemed high in the first cluster, in which the teachers' profiles were highly supportive. In other words, the important factors that made up this cluster were high autonomy support, structure, and teacher involvement. Approximately 15% of the teachers were in the second cluster. The teacher behaviors in the second cluster seemed to be gathering around the midpoint of the scale, and thus the teachers' profiles in the second cluster were found to be moderately supportive. Therefore, the teachers were found to provide a highly supportive attitude in most of the science classes, while those in the remaining science classes seemed to provide moderate support. Though it should not be forgotten that this may be related to the selected sample, it can still be considered satisfactory because teachers' support plays an important role in both motivation and engagement of students (Fredricks et al., 2004; Kuh et al., 2006; Lam et al., 2012; Lietaert et al., 2015; Rolland, 2012; Tas, 2016). Undoubtedly, in learning environments where students are cared for and given the feeling that their wishes are considered, student interest and engagement in the course are likely to increase (Patall et al., 2018; Tsai, Kunter, Lüdtke, Trautwein, & Ryan, 2008). As regards teachers, such environments seem to increase their self-confidence and enable them to enjoy job satisfaction (Cheon, Reeve, Yu & Jang, 2014). Thus, teachers' sense of control over their behavior increases; the feeling of pressure and strain is minimized (Costa, Soenens, Gugliandolo, Cuzzocrea & Larcan, 2015).

The present study compared the collective engagement levels of students with different science teacher profiles. The results showed that the students' collective engagement was higher in science classrooms, with teachers' showing higher levels of supporting behavior than those with teachers showing moderate level behavior. In other words, students were more likely to focus their attention, display effort, participate verbally, persist during the challenge, and have a positive emotional tone when their teachers were more need-supportive. This finding is in line with the premises of the SDT since it links the characteristics of the learning environment with students' motivation and engagement in the course (Reeve, 2012; Reeve, Deci, & Ryan, 2004). If the social environment meets the psychological needs of individuals, individuals will be able to engage emotionally, behaviorally, and cognitively in their environment (Connell & Wellborn, 1991). Among the factors that stand out in influencing the motivation of individuals in the social environment are the teacher's support for students' autonomy and the structure provided by the teacher in the classroom environment (Connell & Wellborn, 1991). Indeed, "Autonomy support is seen as promoting both autonomy and relatedness satisfaction, and when it occurs along with structure, competence as well." (Ryan & Deci, p. 3).

Autonomy support shown in the classroom environment plays a critical role in students' engagement (Cheon, Reeve & Song, 2016; Cheon, Reeve & Vansteenkiste, 2020; Jang et al., 2016; Lietaert et al., 2015; Reeve, 2013; Reeve & Tseng, 2011; Uçar & Sungur, 2017). In the classrooms where autonomy support is provided, teachers consider students' thoughts, feelings, and behaviors, and in return, students can ask questions freely, share their ideas, and choose activities in line with their interests and wishes. Moreover, with the autonomy support provided by a teacher in the classroom, students are likely to concentrate more, thereby showing more effort to achieve the given task (Jang et al., 2010). Based on our findings, which are compatible with the literature, it could be concluded that the teachers fed the students' internal motivation by giving them enjoyable and challenging tasks, that they used informative language instead of controlling language, and that the collective engagements of the students in the science classes where the teachers recognized and took the students' perspectives and feelings were at a higher level. Teachers who are satisfied with their need for relatedness can establish real and sincere relationships. In classrooms where teachers provide a high level of support, students' motivation and class participation have increased. Teachers with high autonomy support feel useful and resourceful, thus achieving more satisfaction in their lives and in their work (Reis, Sheldon, Gable, Roscoe & Ryan, 2018).

The teachers' structure support, which is another teacher behavior used in creating the clusters in this study, denotes the idea that teachers should guide their students step by step to become successful in a given task (Vansteenkiste et al., 2012), as well as giving constructive and positive feedback (Carpentier & Mageau, 2016;

Mouratidis, Michou, Aelterman, Haerens & Vansteenkiste, 2008). Teachers with such characteristics are likely to increase their student's engagement with the lessons (Cheon et al., 2016; Jang et al., 2016; Reeve, 2013; Reeve & Tseng, 2011; Uçar & Sungur, 2017). As similarly mentioned in the relevant literature, this result shows that students tend to exhibit a higher collective engagement in science classrooms where teachers are clear, predictable, and understandable (clear expression of learning goals) and use informative and constructive feedback in classroom environments where they support students (strong leadership, multi-dimensional support). Teacher involvement, the last teacher behavior examined in this study, is an important predictor of student engagement (Tucker et al., 2002; Vollet et al., 2017). The more positively the teacher interacts with and supports students, the more positive response the students will give (Valdes et al., 2021). Likewise, the more teacher involvement students feel, the greater their engagement in the lesson (Hornstra et al., 2021; Hospel & Galand, 2013; Sierens et al., 2009; Skinner & Belmont, 1993). In our study, we found higher collective engagement of the students in the science classes with teachers who showed their care and compassion and spared enough time for their students.

Given the findings, it can be assumed that teacher behaviors play a crucial role in students' collective engagement. It is noteworthy that there is a statistical significance between the mean collective engagement scores of the students in both groups. The moderately supportive teacher profile indicates that student engagement is low; that is, it is below the mean score of the scale, which is 4. Based on such results, it can thus be concluded that if high student engagement is to be achieved, the teacher profiles should be above moderate. Teachers' structure and autonomy support in the learning environment is regarded as student-centered teaching (Jang et al., 2010; Reeve & Jang, 2006; Sierens et al., 2009). A teacher who adopts such an approach supports the development of students' self-confidence by allowing them to make choices in the lesson. Also, non-controlling informative language, listening to students, and responding reasonably (autonomy support) help a student feel important. In this way, teachers can help the students to develop their creativity, find original ideas, and come up with solutions. Science teachers who are capable of demonstrating strong leadership during the lesson, supporting their students with tips and reminders, providing a clear and understandable lesson organization, and finally giving instructive and informative feedback (teachers' structure support), and those who can communicate closely with students and make use of their care and energy for their students (teachers' involvement) can help students not only to be more active but also to be more attentive and persistent in their assigned tasks. Teacher involvement helps teachers be energetic, effective, and passionate about their work. In other words, involved teachers can motivate themselves and act effectively and energetically in the given tasks (Klassen et al., 2012). Success, power, and relationships support both functionality and harmony of individuals (Patrick, Knee, Canevello & Lonsbary, 2007).

Recommendations

Structured teaching activities supporting autonomy are an ideal example of motivation that may have important and wide-ranging educational benefits. Teachers who know how to support autonomy and establish structure and practice it in their classrooms will likely foster increased student motivation and engagement. Apart from these, adopting such an approach will help them perform their job devotedly, besides establishing a sound and satisfying relationship with their students (Cheon et al., 2020). In this regard, teachers can be trained to increase their autonomy support, involvement, and structure support. The training content may cover topics such as giving students a chance to choose among different activities, as well as how to be clear and understandable about their expectations from the students. By conducting experimental studies, the impact of such training on student engagement in a course could be examined more. Thus, it would be possible to establish a cause-and-effect relationship between teachers' structure support, involvement, autonomy support, and student engagement. Future studies may focus on discussing students' views on the classroom environment through interviews with students in addition to classroom observations. Furthermore, by interviewing the teachers, it can be attempted to reveal the reasons for displaying their relevant behaviors in the classroom and their views on the effects of such behaviors on their students.

This study designated the science course for its purposes and examined the behaviors of science teachers and the collective engagement of students in science lessons. We believe comparing the results by conducting similar studies in other disciplines will be useful. Finally, the study has some limitations that should be acknowledged. It should be noted that convenience sampling used for selecting the classes in which the observations were made in this study limited the generalizability of the results. The results obtained from this study are limited to observing 41 science teachers and their students for one course hour. Including more classes may be useful to reveal additional teacher profiles, if any. The only data collection tool was an observation form; interviews with students and teachers can be accompanied for gathering more detailed data. Additionally, no pilot study was conducted before the main study, which is another limitation.

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No potential conflict of interest was reported by the authors.

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Appendix: Turkish version of the observation form

ÖĞRETMEN ÖZERKLİK DESTEĞİ

Dışsal motivasyonel kaynaklara dayanır	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**İçsel motivasyonel kaynaklara dayanır**
• Teşvikler, sonuçlar • Yönergeler-talimatlar, Zaman sınırlamaları • Görevler (ödevler) verme • Uyum arama								• İlgi, zevk • Zorlayıcı görev • Yeterlik/ güven • Seçim yapma
Kontrol edici dil	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Resmi olmayan (gündelik) dil**
• Kontrol altına alan, zorlayan • Gerekli, zorunlu, mecburi • Baskılayıcı, kesin								• Bilgilendirici • Esnek • Kontrol altına almayan
Dersin/görevlerin/davranışların değer ve önemini ihmal eder	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Dersin/görevin/davranışların önemini ve değerini vurgular**
• Değer, anlam, kullanış, fayda ve önemini ihmal eder								• Değerini, anlamını, kullanımını, faydalarını ve önemini vurgular "bu önemli, çünkü…."
Olumsuz duygulara karşı tepki: Olmadı; değiştir onu	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Olumsuz duygulara karşı tepki: Tamam; dinler, kabul eder**
• Olumsuz duygular kabul edilemez • Düzeltmeye, önlemeye veya başka bir şeye dönüştürmeye çalışır								• Dikkatlice dinler • Şikâyetlere açıktır • Kabul eder ve tepkiyi makul karşılar

ÖĞRETMEN KATILIMI

Soğuk, mesafeli görünüyor	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Sıcak, içten görünür**
• Ciddi • Öğrencilerle birlikte vakit geçirmekten hoşlanmaz.								• Duygularını belli eder, ilgi gösterir • Öğrencilerle birlikte vakit geçirmekten hoşlanır
Kişisel kaynaklarını esirger (kısıtlar)	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Kişisel kaynaklarını kullanır**
• Zaman, ilgi, enerji								• Zaman, ilgi, enerji
Fiziksel yakınlık: Uzak	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Fiziksel yakinlik: Yakın**
• Mesafeli durur								• Öğrencilere doğru yürür

Öğrencileri bilme durumu: Hayır, bilmez • Öğrencilere isimleri ile hitap etmez, öğrencilerin akademik veya kişisel geçmişlerinden bahsetmez	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Öğrencileri bilme durumu: Evet, detaylı bilgiye sahiptir** • Öğrencilere isimleri ile hitap eder, öğrencilerin akademik veya kişisel geçmişlerini bilir

ÖĞRETMENİN YAPISI

Girişte / yönlendirme yaparken								
Hiç yok, kafa karıştırıcı, belirsiz, karmaşık • Kurallar ve prosedürler karmaşık, yok • Çok az ya da hiç düzen yok • Hiç yok, kafa karıştırıcı, belirsiz, karmaşık	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Açık, tahmin edilebilir, anlaşılır, detaylı** • Açıkça belirtilmiş prosedürler • Gelecek dersin çerçevesini iyi bir şekilde çizer • Açık ve anlaşılır bir düzen
Ders sırasında/ öğrenciler öğrenirken								
Kötü liderlik • Liderlik etmekte başarısızlık • Plan yok, hedef yok	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Güçlü liderlik** • Düzenli lider, kılavuz • Açık plan, açık hedefler
Az, kolay iş yükü • Az zorlanma, düşük tempo • Çok az kapasite kullanmasını gerektiren görev verme	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Çok, zor iş yükü** • Çok zorlama, yüksek tempo • Çok fazla kapasite kullanmasını gerektiren görev verme
Hiç destek sağlamaz • İpuçları, hatırlatmalar yok • Öğrencilerin soruları kaçırıldı, yetersiz cevaplar verildi	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Çok yönlü destek olma** • İpuçları, hatırlatıcılar • Sorulara iyi ve tam cevap verir
Geribildirim esnasında, performans sonrası yorumlama • Yok, belirsiz, konuyla ilgisiz, konudan konuya atlayan	**1**	**2**	**3**	**4**	**5**	**6**	**7**	• Beceri kazandıran, bilgilendirici, öğretici

ÖĞRENCİNİN TOPLU (KOLEKTİF) KATILIMI

Dikkat dağınık	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Odaklanılmış İlgi**
Pasif, yavaş, az çaba	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Aktif, çabuk, yoğun çaba**
Sessizlik	**1**	**2**	**3**	**4**	**5**	**6**	**7**	Sözel Katılım

• Öğrenciler konuşmaz, soru sormaz, tartışmaz								• Öğrenciler konuşur, soru sorar, tartışır
Zorlanma, başarısızlık veya kafa karışıklığı sırasında								
Kolayca pes eder	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Israr eder**
• Zamanla gösterdikleri çaba azalır								• Zamanla gösterdikleri çaba artar
Tatsız duygu hali	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Pozitif duygu hali**
• Sıkılmış, ilgisiz, tatsız								• Hoşnut, ilgili, eğlenceli