



# Student engagement and teacher emotions in student-teacher dyads: The role of teacher involvement

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## ABSTRACT

**Aims:** We investigated teacher emotions and individual students' engagement in real-time classrooms and considered the role of teachers' involvement level.

**Methods:** The sample included 20 teachers in Taiwanese public primary schools and four target students for each teacher (80 target students in all). Teachers reported their own emotions and each student's engagement at the end of each lesson for a calendar week ( $n_{ti} = 249$ ).

**Results:** T-tests showed that teacher-student relationships are a reflection of teachers being relatively more involved with students they had both close and conflictual relationships with. For students with whom the teacher was relatively more involved, multilevel structural equation models (MSEM) showed they were more engaged in lessons and had a stronger effect on teachers' positive and negative emotions.

**Conclusion:** This study expands the understanding of teacher-student dyads in the real-time classroom by demonstrating the effect of individual students' engagement on teachers' positive and negative emotions by taking teachers' involvement levels into consideration.

## 1. Introduction

Teacher and student emotions play an essential role in students' learning and also in teachers' teaching careers and their well-being. Investigating teachers' emotions is important for understanding teachers' needs and challenges of teaching (Schutz, 2014). Although research has mostly focused on the dynamics between teachers and students generally in the classroom, teachers do react differently to individual students in the classroom and this, in turn, has an impact on both teachers and students (Newberry & Davis, 2008). To understand how students and teachers can foster each other's positive emotional experiences in the classroom in a reciprocal way, it is important to investigate teacher-student dyads and their relationships and behaviours. However, to date, little is known about teacher-student dyads regarding their behaviours, relationship qualities, and emotional experiences in the classroom.

There has been a growing interest in understanding emotional experiences in school settings with researchers increasingly investigating the importance of linking teachers' emotions with their students' engagement and emotions in the classroom (e.g., Frenzel et al., 2021). Drawing on Fredrickson's broaden-and-build theory (Fredrickson,

2004), teachers' positive emotions could enhance their own well-being and their ability to deal with the challenges of their work. Theoretical models regarding teacher emotions and well-being suggest that teacher emotions reflect their reactions towards the behaviours of particular students in the classroom (Frenzel, 2014; Spilt et al., 2011). Interestingly, negative student behaviours do not necessarily lead to teachers' negative emotions. Thus, it is important to consider and investigate how teachers interpret the dyadic relationship with a student. However, most research has focused on finding links between students' negative behaviour (e.g., teachers' perceptions of student disruptive behaviour) and higher levels of teacher stress and burnout, and lower levels of well-being. We argue that it is crucial to investigate the effect of individual students' positive behaviour (e.g., engagement) on teachers' emotions. Since teachers might experience higher levels of conflict and closeness with students who exhibit more disruptive behaviour from the teachers' perspective (Spilt & Koomen, 2009), the meaningful effort teachers put into specific students may contribute to teachers' emotional reactions to students' behaviours (Spilt et al., 2011).

Given the scarcity of existing research on teacher-student dyads in relation to teacher emotions and student engagement, the main aim of this study is to investigate teacher emotions and individual students'

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engagement in the real-time classroom, considering the teacher-student relationship as the context. Our novel design of teacher reports of four target students each lesson during one calendar week enabled us to study teachers and individual students in the classroom.

### 1.1. Teacher emotions in the classroom

Teacher emotions, like student emotions, are prevalent in school settings. In the classroom, teachers' emotions are primarily related to the academic activity (e.g., instructions) and outcomes, which are also known as academic emotions (Pekrun et al., 2002). As an emotional practice, teaching includes the interaction between the teacher, a group of students, and individual students (Hargreaves, 2000). Teacher emotions are seen as an important bridge connecting teachers' perceptions of their teaching goals and student behaviours, and teachers' interpersonal behaviour (Frenzel, 2014). Moreover, teachers' emotional experience from lesson to lesson could shape their general well-being (Spilt et al., 2011) and contribute to students' emotions and learning (e.g., Becker et al., 2014).

Previous research has demonstrated that teachers experience a wide range of positive and negative emotions, such as enjoyment, anger, pride, anxiety, disappointment, relaxation, boredom, and disappointment from lesson to lesson (e.g., Donker et al., 2020; Goetz et al., 2015). Some studies (e.g., Banerjee et al., 2017; Frenzel et al., 2020) found that teachers' positive emotions can lead to the students' positive outcomes and help build a positive classroom climate. This highlights the importance of understanding teachers' emotions in the classroom. However, despite research suggesting that individual students may play a substantial role in teachers' emotional experiences and may affect the same teacher in different ways (e.g., Bardach & Klassen, 2021; de Ruiter et al., 2020; Spilt et al., 2011), little is known about the underlying mechanisms for this.

### 1.2. Student engagement and teacher emotions

#### 1.2.1. The concept of student engagement

Student engagement, as the reflection of student motivational behaviour in the classroom, can play an important role in students' achievement and teachers' emotions (Frenzel, 2014). According to Skinner and colleagues, student engagement is 'the quality of a student's connection or involvement with the endeavour of schooling' (Skinner et al., 2009, p. 494), suggesting that students engage physically and emotionally with their learning reflecting their participation, involvement, and connection to the school and learning tasks (Skinner, 2016). Although there might be an overlap between student motivation and engagement concepts, engagement is more than motivation. Motivation is a student's tendency, direction, and drive toward learning, while engagement involves thoughts and behaviour that demonstrate that tendency and drive (Collie & Martin, 2019).

As an active and observable element of students' presence in the classroom, student engagement is commonly studied as a multi-dimensional construct comprising different dimensions like emotional engagement, behavioural engagement, and cognitive engagement. Among these dimensions, behavioural and emotional components may be the most basic and suitable for studying children (Skinner & Belmont, 1993). Children with high behavioural engagement demonstrate sustained and active behavioural involvement, such as effort in learning activities. Children who are emotionally engaged show interest and positive reactions to the learning activities overall.

#### 1.2.2. The relationship between student engagement and teacher emotions

Frenzel (2014) pointed out that teachers' perceptions of students' motivational behaviour (i.e., student engagement) are one of the four important factors, including achievement, motivational, socio-emotional, and relational behaviour in the classroom. It affects teacher emotions and teachers' following instructional behaviour.

Student engagement might trigger teachers' emotions, such as anger and enjoyment (e.g., Hagenauer et al., 2015; Prosen et al., 2011). Based on Frenzel's model of teacher emotions (Frenzel, 2014), the congruence between teachers' perceptions of student behaviours and teachers' teaching goals triggers their evaluation of how successful their teaching is, and further interprets their emotions as positive or negative. Intriguingly, apart from the relatively well-studied student achievement behaviour (e.g., students' mathematical skills), student engagement appears to be another significant criterion that teachers use to evaluate their teaching (Jacob et al., 2017).

Previous studies show that perceived student engagement plays a crucial role in teachers' emotions. Compared to teachers' self-efficacy, student engagement is a stronger predictor of teachers' joy and anger (Hagenauer et al., 2015). Teachers' evaluation of student engagement as a whole class (group-level) predicts higher teacher enjoyment ( $\beta = 0.25$ ,  $p < .001$ ) and lower anger ( $\beta = -0.18$ ,  $p < .05$ ) when considering other factors (e.g., self-efficacy, lack of discipline, closeness between the teacher and students). Similarly, in a 3-wave longitudinal study, Frenzel et al. (2018) found that teachers' perceptions of student engagement at time 2 predicted teachers' enjoyment at time 3 ( $\beta = 0.52$ ,  $p < .01$ ), and student enjoyment at time 1 predicted teachers' enjoyment via teacher-perceived student engagement at time 2 ( $\beta = 0.21$ ,  $p < .05$ ). Thus, when teachers feel students are behaviourally and emotionally engaged in the learning activities, they experience higher levels of positive emotions and lower levels of negative emotions.

Using a diary method in secondary schools, Becker et al. (2015) found that student-reported class motivation (e.g., I enjoyed this lesson) predicted both teachers' enjoyment ( $\beta = 0.37$ ,  $p < .001$ ) and anger ( $\beta = -0.24$ ,  $p < .01$ ). However, teachers' appraisals mediated the relationships between student-reported class motivation and teacher emotions, underlining the crucial role of teachers' perceptions once more. In addition, a study found that when teachers perceived students' greater prior engagement, they were more likely to show greater genuine expression rather than a fake expression of positive emotions at a later stage (Wang et al., 2021). Teachers' perceptions of student engagement were thus associated with teachers' emotional displays.

To summarise, few studies have focused on how student engagement in school settings contributes to teachers' positive and negative emotions (e.g., Becker et al., 2015; Frenzel et al., 2018; Hagenauer et al., 2015; Martin, 2006). In addition, further knowledge of real-time dynamics from teachers' perspectives in primary schools is needed, especially in school contexts (Frenzel et al., 2021). Moreover, previous research has used teachers' ratings of the general classroom rather than of individual students, which may have overlooked the effects of individual students on teachers' emotions. We have extended previous studies by investigating the effects of teacher-perceived individual students' engagement on their positive and negative emotions during lessons over a week. The following sections review teachers' relationships with, and emotional reactions to, individual students.

### 1.3. Teachers' perceptions of individual students' behaviour

Classroom dynamics involve teachers interacting with the whole class and with individual students. Although the effect of teachers' different expectations of individual students has been researched for some time (Denessen et al., 2020), the effect of individual students on teachers, especially teachers' emotional experience, has been investigated relatively rarely.

Models of teachers' emotions and well-being suggest that the events (student behaviour) teachers face in their daily lives in school settings trigger their emotional experiences (Frenzel, 2014; Spilt et al., 2011). Research has focussed on the relationship between teachers' emotions and students' behaviour in general, especially their perceptions of student misbehaviour or disruptive behaviour (Aldrup et al., 2018). However, an interesting question remains: Since not all students act the same way in the real-time classroom, whose behaviour matters more to

teachers? Evidence shows that not all students receive teachers' attention equally in the classroom, implying different levels of involvement by the teachers. Moreover, a study using the eye-tracking method found that only a few students capture preservice teachers' attention while they are teaching (Stürmer et al., 2017).

Research has shown that teachers' perceptions of individual students' disruptive behaviours trigger teachers' emotions and their daily occupational well-being (de Ruiter et al., 2020). In a study investigating the effect of teachers' perceptions of individual students' disruptive behaviour on teachers' emotions (e.g., enjoyment and anger) elicited by events in the classroom, teachers tended to react with negative emotions to students they had perceived as having more prior disruptive behaviour (de Ruiter et al., 2020). That study also showed that when reacting to a negative event involving students who were perceived as more habitually disruptive, teachers may have stronger negative emotions.

Thus, individual students' behaviour in the classroom may trigger teachers' different intensities of emotional response. Although most research has focused on the negative indicators of student behaviour, we proposed that the positive indicators of individual students' behaviour (= student engagement) could also lead to different intensity levels of teachers' emotions.

#### 1.4. Teachers' involvement and relationship with individual students

The relationship between teachers and students is seen as a substantive factor in students' learning and emotions (Goetz et al., 2021). It is also critical to teachers' emotional experiences, such as stress and emotional exhaustion (e.g., Gagnon et al., 2019; Taxer et al., 2019). Furthermore, the teacher-student relationship could be more intense in primary school classrooms compared to secondary school classrooms (Hargreaves, 2000). Owing to the intensive and fast-paced nature of primary classrooms, primary school teachers could have more intense and stronger emotional incidents. Interestingly, many primary school teachers find their relationships with children rewarding.

Generally, the teacher-student relationship includes three aspects: closeness, conflict, and dependency. Among these, closeness and conflict are widely used to define and test the relationship between teachers and students. Closeness means a feeling of warmth and having open communication, while conflict indicates interactions with negativity and struggling (Pianta & Stuhlman, 2004; Spilt & Koomen, 2009). Regardless, it is thought that teachers feel a closer relationship when they have a low level of conflict with a student; however, empirical research has shown that teachers can feel close but also conflictual with the same student (Spilt & Koomen, 2009). This reveals the complex nature of the teacher-student relationship, indicating that feeling close and conflictual are not mutually exclusive.

Teachers' mental representation of their relationship with a particular student can involve how much effort they exert and how meaningful their action is. A study exploring primary school teachers' conceptions of closeness via classroom relationships highlighted three factors (i.e., negotiating personality, teachers' perceptions of being pressed by a child for building the relationship, and dealing with challenges) shaping teachers' experiences of their relationships with students and their interactions with individual students (Newberry & Davis, 2008). From the teachers' perspective, a match-mismatch between their own and their students' personalities (e.g., bright or polite students) is one important factor that affects their tendency to feel close to, or pay more attention to, a particular student. In contrast, some characteristics such as being too quiet, too shy, or self-reliant, may not catch the attention of teachers and this leads to a distant relationship (e.g., lack of closeness and conflict). Intriguingly, dealing with student challenges does not necessarily lead to conflict or distant relationships. However, whether the challenges cause the teachers to put more time and effort into reflecting on the challenges, makes a difference. Additionally, whatever the challenge or personality, it is easier for teachers to respond to a child if they feel urged by a student to build a closer

relationship. Although the study of Newberry and Davis (2008) focused mainly on close but not conflictual teacher-student relationships, it indicates that teachers' attention to a particular student for different reasons (e.g., an "intelligent" student, teachers' evaluation of the challenges, and pressure to build up the relationship) could increase their actions towards building the relationship and their responses to a student.

Contrary to a commonly held belief that teachers interact more with high achievers, two previous studies have suggested that teachers can be more involved with students who are relatively lower performers, while this may not be the decisive factor. Denessen et al. (2020) found that teachers tend to provide more feedback and interact more frequently with their low-performing students in primary schools. Malmberg and Martin (2019) found that teachers were involved more with students who were less task-focused and less competent in class.

Taken together, previous findings highlight that the teacher-student relationship is crucial for both teachers and students. However, teachers' emotional experiences in the classroom may reflect how much attention, involvement, or effort they direct toward individual students, which in turn can be mediated by the teacher-student relationship. To this end, we investigated the role of teachers' involvement in student engagement and teachers' own emotions.

## 2. The present study

As shown in the proposed model (see Fig. 1), the present study aimed to investigate the dyadic relationships between teachers' emotions and individual students' engagement in real-time classrooms, considering the role of teachers' involvement level with their students. Specifically, we examined the following research questions:

1. What are the characteristics of students that teachers are relatively more or less involved with?
2. How does teacher involvement predict teacher-perceived student engagement and teacher emotions?
3. How does teacher-perceived individual student engagement predict their own emotions?
4. Are there differences between teachers with regard to how involvement with students predicts student engagement, and how this in turn predicts teachers' own emotions?

To reflect the different teacher-student links in teachers' emotions elicited by students' engagement, we designed our study to ask teachers to report on four target students' engagement during each lesson. We asked each teacher to select four target students according to their involvement with students in previous lessons.

It is likely that teachers' selection of students according to their involvement level would reflect their relationship with the students and their academic performance. We assumed that teachers might have higher levels of closeness or conflictual relationships with students with

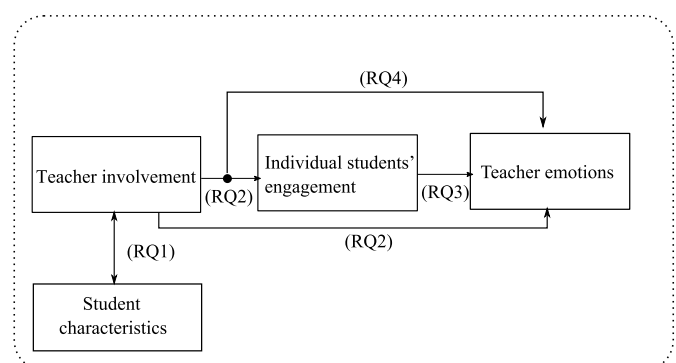


Fig. 1. Conceptual model.

whom they had been relatively more involved in previous lessons (Newberry & Davis, 2008). Further, we anticipated that teacher-perceived student engagement correlates with teachers' involvement levels and their positive emotions. Also, the relationship between teacher involvement and student engagement is to some extent linked with teachers' emotions.

### 3. Method

#### 3.1. Participants and procedure

Micro-longitudinal research was conducted in two cities in Taiwan to investigate the research questions. By using a micro-longitudinal design, we captured teachers' perceptions of student engagement and their own emotions through a series of repeated measurements at the end of each lesson, reducing the retrospective bias and enhancing contextual closeness (Bamberger, 2016; Bolger, Davis, & Rafaeli, 2003). Ethical approval was obtained before the recruitment. In total, the head teachers of eight primary schools agreed to join the research. Homeroom teachers<sup>1</sup> who taught Year 4 or 5 were invited to participate. If teachers consented to join the research, their students were invited to participate, and informed consent was obtained from both parents and students (for more information please see Li et al., 2022).

In total, 20 homeroom teachers (two men and 18 women) and their 308 students (164 boys and 144 girls) from Years 4 and 5 participated. To understand the teacher-student dyads in the classroom, teachers were asked to nominate 4–6 students to whom they pay relatively more attention in class (higher level of involvement) and 4–6 students to whom they pay relatively less attention (lower level of involvement). Four out of the teacher-nominated students were selected for the teacher to report on in the current research, i.e., two students whom the teacher was relatively more involved with and two students whom the teacher was relatively less involved with. Therefore, participants in this study included 20 homeroom teachers and each of their four target students, meaning a total of 80 individual students (out of 308 students).

Each lesson during the week, teachers rated themselves and their four target students (46 boys and 34 girls) in relation to emotions and engagement. Similarly, students also rated themselves and their homeroom teachers. The age of the teachers ranged from 28 to 55 years old ( $M = 43.05$ ,  $SD = 9.01$ ) and they reported an average of 16.13 years of teaching experience ( $SD = 8.56$ ). Student age ranged from 9.25 to 11.67 ( $M = 10.45$ ,  $SD = 0.69$ ). Among the students, 45% were in Year 4, and 55% were in Year 5. Students' average performance (mean score in Mandarin and Mathematics) was 84.07. In general, the teachers reported a relatively higher level of closeness and lower level of conflict with their target students (see Table 1).

#### 3.2. Measures

Teachers completed a short-form questionnaire for each student who participated in the study, responding to questions designed to assess the teacher-student relationship. In addition, information on students' academic performance was collected. During the intensive data-collection period, teachers reported on their own emotions throughout each lesson and the engagement of the four target students. Students were unaware that they were target students.

##### 3.2.1. Teachers' perceptions of teacher-student relationship

The teacher-student relationship was measured with 15 items on a

<sup>1</sup> Homeroom teachers in Taiwan teach multiple subjects (e.g., Mandarin, mathematics, and Integrative Activities) to the same class. They also have the responsibility to communicate with parents and lead the class. In general, homeroom teachers in primary schools teach 15–16 lessons per week (also see Li et al., 2022).

**Table 1**  
Participant characteristics.

		M	SD	N	%
<b>Teacher</b> (N = 20)	Gender				
	Man			2	10
	Woman			18	90
	Year group taught				
	Year 4			9	45
	Year 5			11	55
	Teaching experience	16.13	8.56		
	Age (Years)	43.05	9.01		
<b>Student</b> (N = 80)	Gender				
	Boy			46	57.5
	Girl			34	42.5
	School year				
	4			36	45
	5			44	55
	Family SES				
	Low-Medium Low			0	0
	Medium Low			2	2.5
	Medium			25	31.3
	Medium High			22	27.5
	High			31	38.8
	Age (Years)	10.45	0.69	80	
Academic performance	84.07	11.50	79		
Teacher-reported T-S relationship					
Closeness	3.83	0.59	80		
Conflict	1.75	0.89	80		

five-point Likert Scale (1: definitely does not apply, 5: definitely apply) adapted from the short version of the Student-Teacher Relationship Scale (STRS, Chen, 2012; Pianta, 2001; Pianta & Steinberg, 1992). In this study, teachers answered eight items of STRS assessing closeness (e.g., I share an affectionate, warm relationship with this child), and seven items assessing conflict (e.g., This child and I always seem to be struggling with each other) considering individual students in the classroom. Internal consistency (Cronbach's  $\alpha$ ) was 0.87–0.93 and McDonald's  $\omega$  was 0.88–0.93 for closeness and conflict.

##### 3.2.2. Teacher emotions

Teachers' lesson-specific emotions were measured using eight discrete positive emotions or negative emotions: enjoyment, pride, relaxation, calm, anger, anxiety, boredom, and disappointment. We selected various common and easily understood emotions in primary school for both teachers and students. Thus, we covered both the high-activation emotions (e.g., enjoyment, pride, anger, anxiety) and low-activation emotions (e.g., relaxation, calm, boredom, disappointment) for both positive and negative emotions (consistent with activating and deactivating emotions, following both activation and valence dimensions of emotions, Pekrun, 2006). Categorising these discrete emotions as positive and negative emotions is supported by a previous Taiwanese study on teacher emotions (Chang & Cherng, 2017) and this was supported by the multilevel confirmatory factor analysis results (Li et al., 2022). The reliability of teacher emotions (Cronbach  $\alpha$  and McDonald's  $\omega$ ) ranged from 0.59 to 0.92 (please see Li et al., 2022 for information).

##### 3.2.3. Teachers' perceptions of student engagement

Teachers' perceptions of individual students' engagement were assessed with eight items measured on a 5-point Likert Scale (1 = not at all, 5 = very true) adapted from the teacher-report questionnaire "Engagement Versus Disaffection with Learning: Teacher Report" (Skinner et al., 2009; Skinner et al., 1990, 1998; Wellborn, 1991). Teachers rated students' engagement during each lesson to assess the degree to which students engaged in their lesson activities and tasks. Behavioural engagement was assessed using four items measuring students' persistence, effort, and attempts in learning tasks or activities. Emotional engagement was assessed using four items related to students' interests and enthusiasm while participating in learning tasks

(Skinner et al., 1998). We adjusted some wording for use in the real-time classroom (e.g., In this lesson, this student participated in discussions). The reliability (Cronbach's  $\alpha$  and McDonald's omega) in the present study ranged from 0.84 to 0.96 across levels (lesson level, student level, teacher level) for behavioural engagement, and 0.89–1.00 (in 2 decimal places) for emotional engagement.

### 3.3. Data analytical strategy

This study aimed to investigate teacher-student dyads in the real-time classroom. The nature of the current data was dyadic and hierarchical (see appendix for the schematic structure of the dataset). Teachers' lesson data were merged with each individual student's lesson data. To understand the characteristics of the target students that the teachers nominated and the effect of their self-report emotions in response to students' engagement considering the different levels of teacher involvement with the students, we applied different analyses to answer our research questions.

We first present descriptive analysis and the characteristics of individual students selected (target students) using SPSS 28. The main analysis was conducted utilising multilevel structural equation modelling with Bayesian estimation in Mplus 8.9 (L. K. Muthén & Muthén, 1998-2017). Bayesian estimation enables researchers to obtain credible parameter estimates with a small sample (e.g., as few as 13 units, Hox et al., 2012; Muthén & Asparouhov, 2012; McNeish, 2019), as it does not rely on large-sample theory (i.e., central limit theorem) but estimates the probability of the parameters based on the given data (Kruschke, 2013). We thus used Bayesian estimation for the relatively small sample size of teachers/classrooms (20 teachers/classrooms at Level 2-b). We incorporated weakly informative admissible-range priors for variance following McNeish (2019) to set boundaries for the variance to let the variances possible to estimate.<sup>2</sup> Weakly informative priors for the means were set to 0, with a variance of 1 in the models. All models were run with 20,000 iterations. The posterior predictive p-values (PPP) were used to evaluate the model fit (PPP > .05). Additionally, the potential scale reduction values (PSR) below 1.05 were also used to examine the convergence (Gelman & Rubin, 1992). Model health was inspected using the Bayesian posterior draw trace plot, potential scale reduction value and auto-correlation plot of parameters (Kruschke, 2015). All models in this study have acceptable PPP values (PPP > .05) and reached convergence (PSR below 1.05). Additionally, predictors were analysed using grand mean centring.

To answer the first research question, we first conducted a *t*-test to examine whether teacher-student relationships (closeness and conflict) and students' academic performance differed according to teachers' involvement. Multilevel structural equation models were then specified separately for teachers' positive and negative emotions. We estimated intraclass correlations (ICC) to investigate the variance in teachers' positive and negative emotions attributed to different levels. We then conducted cross-classified multilevel models (lessons nested within students and teachers) to examine the relationship between individual students' engagement, teacher involvement and teachers' emotions to answer research questions 2 to 4. Specifically, we specified a set of fixed-effect cross-classified models to answer the second and third questions. For the fourth question, we specified a set of random slope models, allowing us to examine the effect of slope and the existence of individual differences.

<sup>2</sup> We based the admissible-range priors on descriptives for the raw data. The total variance ( $\sigma_T^2 = 0.51$ ) was partitioned into within-level, student-level, and teacher-level variances (e.g., student engagement:  $\sigma_W^2 = 0.20$ ,  $\sigma_{\text{BStudent}}^2 = 0.15$ ,  $\sigma_{\text{BTea}}^2 = 0.16$ ), and an inverse gamma prior with shape = 3 and scale = 0.4 would reasonably give the interval for a conservative mode of 0.1.

## 4. Results

### 4.1. Descriptive analysis

Table 2 summarises descriptive results (e.g., means, standard deviations, correlations) of the variables. Means, standard deviations, and intercorrelations of variables are presented as occurring across lessons, students, and teachers (Level 1), between students (Level 2-a), and between teachers (Level 2-b). Generally, teachers reported relatively high positive emotions across lessons, students, and teachers ( $M = 3.62$ – $3.64$ ) and relatively low negative emotions ( $M = 1.86$ ). Teachers' average rating of individual students' behavioural and emotional engagement was higher than the midpoint of the 5-point Likert Scale. Overall, the correlations revealed a positive relationship between teachers' positive emotions and student engagement and a negative relationship between teachers' negative emotions and student engagement.

The intraclass correlation (ICC) demonstrated that between-teacher variability of teacher emotions ranged from 0.60 to 0.61, indicating that most of the variance was from variation between teachers, although a substantial variance accounted for between-lesson variation (approximately 0.38 and 0.40 for positive and negative emotions). Note that there was no between-student variance. This is because teachers rated their own emotions once per lesson (as did each of the four students). Teachers did not report their emotions for each student separately.

For students' engagement we see another pattern of intraclass correlations, with the most variance between lessons (0.37–0.41), and quite equally between students (ICC = 0.25–0.28) and teachers (ICC = 0.34).

In the correlations, we also see that (1) the associations between emotional and behavioural engagement were very high at the student and teacher levels. For this reason, we merged student engagement into one construct for the analyses, and (2) teachers' emotions were unrelated to teacher involvement, while it was positively associated with student engagement.

### 4.2. Characteristics of individual students

In order to answer the first research question, we investigated mean-level differences in closeness, conflict and academic performance, between target students with whom the teacher was relatively more and less involved, using *t*-tests ( $n = 80$ ). As shown in Table 3, target students with whom the teacher was relatively more involved, had higher levels of both closeness ( $t(78) = -2.14$ ,  $p = .036$ ) and conflict ( $t(78) = -2.96$ ,  $p = .004$ ) with teachers. However, no significant differences in academic performance ( $t(77) = 0.82$ ,  $p = .414$ ) were found. This then pointed out that the teacher involvement level reflects teachers' relationship with individual students in the classroom. Interestingly, when we observe the associations between student characteristics in the two groups separately (high vs. low teacher involvement), higher academic performance was associated with higher closeness, and closeness in turn associated with less conflict, among the students with whom the teacher was more involved.

### 4.3. The association between teacher involvement, teacher-perceived student average engagement, and teacher emotions

To understand how teachers' involvement levels affect their judgement regarding student engagement (RQ2), and how student engagement predicts teacher emotions in the classroom (RQ3), we first specified fixed-effect cross-classified models for positive emotions and negative emotions, respectively (Fig. 2(a)).

With regard to RQ2, our results revealed that teacher-rated student engagement differed based on the teacher's level of involvement. Teachers were more likely to rate students with whom they were relatively more involved as having higher levels of engagement ( $\beta = 0.17$ , C. I. [0.11, 0.23]).

For the relationship between student engagement and teacher

**Table 2**  
Descriptive statistics and correlations for the study.

Lessons (within)	n	M/%	SD	ICC(w)	1.	2.	3.	4.
1. TPE	996	3.62	0.62	0.38				
2. TNE	996	1.86	0.69	0.40	-0.61			
3. TSENB	981	3.65	0.71	0.37	0.47	-0.29		
4. TSENE	981	3.69	0.73	0.41	0.47	-0.33	0.86	
5. Involvement	1100	50%			0.00	0.00	0.13	0.19
Students (between)	n	M/%	SD	ICC(s)	6.	7.	8.	9.
6. TPE	80	3.63	0.47	0.003				
7. TNE	80	1.86	0.51	0.002	-0.77			
8. TSENB	80	3.69	0.58	0.28	0.61	-0.39		
9. TSENE	80	3.75	0.58	0.25	0.62	-0.47	0.94	
10. Involvement	80	50%			0.00	0.00	0.18	0.25
Teachers (between)	n	M/%	SD	ICC(t)	11.	12.	13.	14.
11. TPE	20	3.64	0.48	0.61				
12. TNE	20	1.86	0.52	0.60	-0.77			
13. TSENB	20	3.69	0.46	0.34	0.79	-0.51		
14. TSENE	20	3.73	0.47	0.34	0.78	-0.60	0.95	

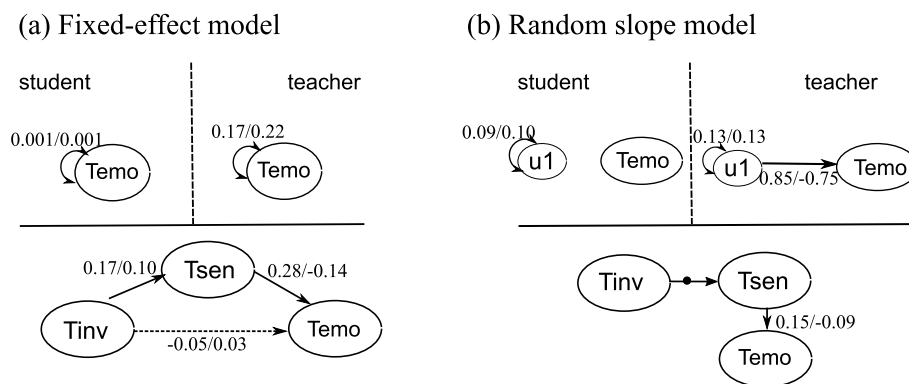
Note: TPE = teacher positive emotions, TNE = teacher negative emotions, TSENB = teachers' perceptions of students' behavioural engagement, TSENE = teachers' perceptions of students' emotional engagement. ICC(w) = intraclass correlation for lesson-level. ICC(s) = intraclass correlation for student-level. ICC(t) = intraclass correlation for teacher-level.

\* $p < .05$ , \*\* $p < .01$ , \*\*\* $p < .001$ .

**Table 3**  
Descriptives, correlations and t-tests for student characteristics.

	Low involvement (n = 40)				High involvement (n = 40)				t-test
	M	SD	1	2	M	SD	1	2	
1 Performance	85.22	8.30	-	-	83.09	14.03	-	-	0.82
2 Closeness	3.69	0.48	-0.07	-	3.96	0.66	0.32*	-	-2.14*
3 Conflict	1.47	0.65	-0.04	-0.14	2.03	1.01	-0.26	-0.68**	-2.96**

\* $p < .05$ , \*\* $p < .01$ , \*\*\* $p < .001$ .



**Fig. 2.** Relationships between teacher involvement, perceived student engagement, teacher emotions

Note: Temo = teacher positive/negative emotions. Tsen = teacher-perceived student engagement. Tinv = teacher involvement. Values before slashes indicate the model of positive emotions, and values after slashes indicate the model of negative emotions. Values before slashes indicate the model of positive emotions, and values after slashes indicate the model of negative emotions.

emotions (RQ3), our model showed that student engagement positively predicted teachers' positive emotions ( $\beta = 0.28$ , C.I. [0.21, 0.36]) and negatively predicted teachers' negative emotions ( $\beta = -0.14$ , C.I. [-0.22, -0.06]). When students had a higher level of engagement in the classroom, teachers tended to experience higher levels of positive emotions and lower levels of negative emotions.

**4.4. Differences between teachers' effects of involvement on engagement and their own emotions**

To understand the effect of the differential associations between teacher involvement, teacher-perceived student engagement, and teacher emotions, we specified a random term (student engagement regressed on teachers' involvement) at the lesson level and inspected the

variance of the slope at the student level, and whether it predicted teachers' emotions at teacher level (see Fig. 2(b)).

**4.4.1. Teacher positive emotions**

With regards to teachers' positive emotions, our results indicate that teacher-perceived student engagement positively predicts teachers' positive emotions at the lesson level ( $B = 0.15$ , C.I. [0.11, 0.20]), similar to our fixed-effect models.

At the student level, the variances of slope (student engagement regressed on teachers' involvement) showed that there were student-level differences in the relationship between teacher involvement and teacher-perceived student engagement ( $\sigma^2 = 0.09$ , C.I. [0.04, 0.20]).

In addition, teachers' positive emotions at the teacher level were predicted by the engagement-on-involvement-slope, namely the

relationship between student engagement and teacher involvement ( $B = 0.85$ , C.I. [0.44, 1.59]). Thus, the steepness of the slope was related to teachers' positive emotions. Teachers' positive emotions were higher when the slope was steeper, indicating when teachers perceived higher student engagement, they were relatively more involved and their positive emotions were higher.

#### 4.4.2. Teacher negative emotions

As shown in Fig. 2(b), the higher the teacher-rated student engagement, the lower the teacher's negative emotions at the lesson level ( $B = -0.75$ , C.I. [-1.56, -0.17]).

The engagement-on-involvement slope at the student level ( $\sigma^2 = 0.10$ , C.I. [0.04, 0.23]) showed that there were differences between students. At the teacher level, a steeper engagement-on-involvement-slope (i.e., students with whom the teacher is involved are more engaged) predicted lower teachers' negative emotions ( $B = -0.75$ , C.I. [-1.56, -0.17]). The steeper the slope, the lower the levels of teachers' negative emotions. In addition, teachers' individual differences regarding the relationship between teacher involvement and student engagement exist ( $\sigma^2 = 0.13$ , C.I. [0.03, 0.30]).

To further explain how the associations between teacher involvement and teacher-perceived student engagement predicted teacher emotions, we plotted the relationship between student engagement and teacher emotions based on teachers' involvement level at the teacher level as Fig. 3. The results indicated a stronger relationship between teacher-perceived student engagement and teachers' positive and negative emotions for students with whom they were more involved than those with whom teachers were less involved.

### 5. Discussion

This study addressed a field that is under-explored in real-time primary school settings. We posed four research questions concerning teachers' emotional experiences as a function of students' engagement and teachers' involvement. First, we explored the characteristics of students with whom teachers are relatively more or less involved. We found that many teachers nominated students with whom they were more involved in previous lessons and were students with whom the teacher had a higher level of close and conflictual relationship. Second, we investigated whether teacher involvement predicts teacher-perceived student engagement and their emotions. We found that the teachers tended to rate students with whom they were more involved as having higher levels of engagement. Third, we examined the effect of

teacher-perceived individual student engagement on teacher emotion and found that perceived student engagement was linked to teachers' positive and negative emotions in different directions. Fourth, we explored whether there were differences between the teachers considering how their involvement predicted student engagement and whether this predicted teachers' emotions. We found that teachers' positive emotions were higher and negative emotions were lower when students with whom teachers were involved more had higher engagement.

#### 5.1. Student-teacher relationships and teacher involvement

One interesting finding is that teachers may have closer and more conflictual relationships with students with whom they were relatively more involved. This result lends further support to our assumption based on Newberry and Davis (2008) that teachers' involvement level with individual students reflects the dyadic teacher-student relationship. Nevertheless, students' academic achievement does not significantly account for teachers' involvement level. The more teachers were involved with a student, the more likely they had a stronger relationship with this student. This finding aligns with previous research indicating that teachers can simultaneously have a close and conflictual relationship with the same student (Spilt & Koomen, 2009). Although student achievement is one major intrinsic reward for teachers, teachers value interactions with their students regardless of specific outcomes (Plihal, 1982). When comparing student performance scores between different teachers' involvement levels, our findings also somewhat echo the previous research that suggested that teachers may be involved more with students who perform poorly (Malmberg & Martin, 2019; Denessen et al., 2020). Our findings thus suggest there might be other factors that affect the relationship between student performance and teacher involvement. It is worth considering teachers' involvement with individual students in building teacher-student relationships.

#### 5.2. Teacher involvement, student engagement, and teacher emotions in classrooms

The relationship between teacher involvement, student engagement, and teacher emotions at the lesson level (RQ2 and RQ3) corroborates previous findings that student engagement is a compelling factor in teachers' emotions (Hagenauer et al., 2015). Moreover, student engagement emerged as a contributor not just to the increased teachers' positive emotions in each lesson but also to the decreased teachers' negative emotions in the lessons. This highlights that student

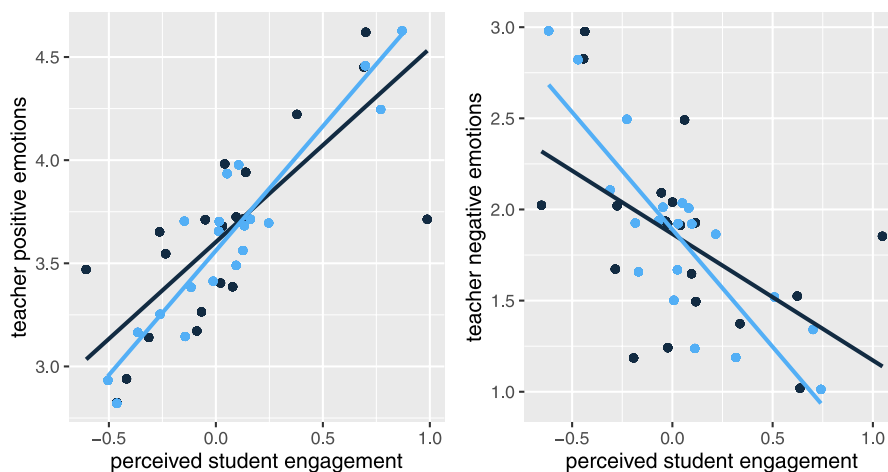


Fig. 3. Teacher emotions regressed on perceived student engagement for students the teacher is relatively less and more involved with. Note: Blue lines represent two target students the teacher was relatively more involved with, and black lines represent two target students the teacher was relatively less involved with. (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

engagement is one aspect that teachers use to judge how successful their teaching is (Frenzel, 2014). Furthermore, teachers' evaluation of students' engagement may be linked to their previous experience with a student, which corresponds with and expands previous research about teacher-student relationships and teacher attention (e.g., Denessen et al., 2020; Newberry & Davis, 2008). One reason is that to what extent a teacher is involved with a student links to the intensity of a dyadic teacher-student relationship, and this further connects to teachers' evaluation of a child.

### 5.3. Teacher emotions as a function of teacher involvement and student engagement

Encouragingly, our study highlighted the proactive role of teachers in their own emotions. Based on the random slope models (as shown in Fig. 2(b)), we found that when accounting for teachers' perceptions of the target student, perceived student engagement was related to teacher involvement. We suggest that perceived student engagement of target students in each lesson matters for teachers' positive and negative emotions. Specifically, through decomposing the relationships between these variables (Fig. 3), we go beyond the previous study (Li et al., 2022) and indicate that teacher involvement levels may interact with student engagement to affect teacher emotions. Thus, we emphasise teachers' proactive efforts in teacher-student interactions and somewhat explain previous research about the effects of students' disruptive behaviour on teachers. (de Ruiter et al., 2020).

Teachers tend to react sharply to a negative event involving a student they view as habitually disruptive, perhaps because they devote more time and effort to this student. When teachers are actively involved with a student, they could build stronger relationships with this student and then affect their evaluations of the extent to which students engage or disengage in the classroom and further determine their corresponding emotions (either positive or negative). It is then important to identify how teachers' involvement develops and support teachers in becoming aware of the impact of their involvement with students.

## 6. Limitations

This study aimed to deepen our understanding of the dynamics between teachers and individual students in the real-time classroom. Although the within-person data was rich, the sample size in the present study is relatively small, with only 20 teachers and each of their four target students (80 students) from the same cultural background. Thus, further research is needed to replicate our results using larger sample sizes in different cultures.

Another limitation of the current research is that it mainly relied on the self-reported data of teachers. Although self-reporting is a crucial source when exploring teachers' emotional experiences (Pekrun, 2016), it would be beneficial for future research to incorporate other methods, such as observations, an ambulatory measurement of participants' blood pressure and heart rate, or multiple reporters to complement the use of self-reporting.

Although we focused on teachers' spontaneous reports of their emotional experiences in each lesson, we did not investigate events (e.g., students solving a task) that triggered teachers' emotions. In addition, this study focused on the link between student-related classroom variables and teacher emotions, but there might be some other teacher variables (e.g., self-efficacy) that could have an impact on teachers' own emotions. Future studies could investigate the trigger of teachers' emotions to explore the link between a specific event as well as teacher variables and teachers' emotional reactions.

Furthermore, to consider our main aim and to lower the burden on the participants, we did not include teachers' perceptions of students' disruptive behaviour. Previous research has indicated that teachers' perceptions of students' disruptive behaviour could lead to an increase in teachers' negative emotional experiences and a decrease in teachers'

positive emotional experiences (Aldrup et al., 2018; Becker et al., 2014). Moreover, teachers could react more emotionally to individual students they perceive as having more disruptive behaviour (de Ruiter et al., 2020). It would be beneficial to investigate teachers' perceptions of students' disruptive behaviour and engagement simultaneously, providing an even more comprehensive view of teachers and individual students in real-time classrooms.

## 7. Conclusion and implication

In conclusion, the findings of this study indicate that the teacher-student dyad in the real-time classroom is an important area of study, and that teachers' involvement with individual students plays an important role in the effect of student motivational behaviour on teachers' emotions.

The present study investigated the relationship between individual student engagement and teacher emotions in real-time primary school classrooms, considering teachers' involvement levels. The findings suggested that teachers' involvement is related to their evaluation of their relationship with individual students. Consequently, teachers' awareness or perceptions of their involvement may reflect their perceptions of student engagement in the classroom and further contribute to their own emotions. Teachers' perceptions of whether their effort is meaningful could contribute to their actions in building relationships with individual students (Newberry & Davis, 2008). Thus, an important implication for policy and school practice is that helping teachers find meaning in their interaction with individual students may help teachers build a more positive and closer relationship with students.

One encouraging finding of the current study is that individual students' lesson-specific engagement is associated with a higher level of teachers' positive emotions, such as enjoyment, pride, calm, and relaxation from lesson to lesson, regardless of the involvement level teachers perceived. In addition, students' engagement could be a protective factor for teachers' negative emotions. This implies that improving students' engagement levels or creating a positive climate in the classroom could help teachers accumulate positive emotional experiences throughout their teaching career, and this may further contribute to their overall well-being.

Another implication relates to the effect of teachers' involvement levels on individual students' engagement being related to teachers' positive emotions at the teacher level. The findings of this study indicated that when teachers see that students to whom they give more attention engage in the lesson, they especially feel a higher level of positive emotions overall. Additionally, when teachers perceived students had higher engagement, they were more likely to have lower levels of negative emotions. Teachers' bonds with individual students and students' engagement could buffer their negative emotions. Thus, interventions that focus on improving teachers' classroom management (e.g., effective ways to motivate students to be actively involved in classroom activities) and teacher-student relationships (Bosman et al., 2021) could also benefit students as teachers.

## CRedit author statement

Pei-Hsin Li: Conceptualisation, Methodology, Software, Formal analysis, Investigation, Data Curation, Writing-Original Draft, Project administration. Diane Mayer: Writing-Review & Editing, Supervision. Lars-Erik Malmberg: Conceptualisation, Validation, Writing-Review & Editing, Supervision.

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## Appendix. Schematic structure of the dataset

Teacher id	Lesson id	Student id	Teacher positive emotion	Perceived Student Engagement
1	1	101	4.00	4.25
1	1	102	4.00	3.00
1	1	103	4.00	4.50
1	1	104	4.00	3.25
1	2	201	3.25	5.00
1	2	202	3.25	4.00
1	2	203	3.25	4.00
1	2	204	3.25	3.75

Note. The dataset presents the structure of the dataset used in this study with virtual values. Teachers reported their own emotions once per lesson, and each of the four target students' engagement once per lesson.

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