

Teachers' emotional experiences in classrooms:

A micro-longitudinal study in Taiwanese primary schools

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ABSTRACT

Given the limited understanding of teachers' momentary emotional experiences and the interplay between teachers and students during lessons in Taiwan, this thesis explored teachers' and students' emotions in real-time in classrooms in Taiwanese primary schools. A conceptual framework is proposed that considers teacher emotions at different time layers and the reciprocal relationships of momentary emotional experiences between teachers and students. Overall, the thesis utilises a micro-longitudinal approach to study the momentary emotions of teachers and students in eight public primary schools in Taiwan.

Following the conceptual model based on theories and previous research, the thesis consists of three empirical studies investigating the emotional experiences of teachers, teachers and their students, and teachers with individual students, respectively. Using a sample of twenty teachers (n_{days}= 90, $n_{lessons}$ = 249), Study 1 investigated the situational, daily, and personal factors that predict teachers' emotions and the association between teachers' momentary emotional experiences and their work-related and general well-being. Specifying multilevel structural equation modelling (MSEM), the study showed that compared to previous studies, the majority of variance in Taiwanese teachers' emotions is among teachers rather than between

lessons. Teachers' perceptions of student behaviour are crucial to their emotions, which predict their daily work-related and general well-being. Study 2 investigated teacher-student emotional contagion from one lesson to another among 20 teachers and their 306 students (Year 4 and Year 5, n_{ti}=3891). MSEM showed that compared to teachers' self-reported emotions, students' perceptions of teacher emotions are relatively more predictive of student emotions. The findings revealed a reciprocal relationship between students' perceptions of teacher emotions and students' self-reported emotions. In addition, it addressed the importance of the lagged effect of teachers' positive emotions on students' emotions. Study 3 investigated the effects of teacher involvement level on teacher-student dyads (four target students for each of twenty teachers, n_{tea} = 20, n_{stud} = 80). Results revealed that teachers' past involvement in the lessons reflects the teacher-student relationship. MSEM demonstrated that target students' engagement predicted teacher emotions in the classroom when they gained a higher level of teacher involvement in previous lessons, implying that teachers react differently to individual students.

Based on the findings of the three studies, the thesis concludes with an overall discussion regarding teachers' and students' emotional experiences in real-time classrooms. Addressing emotional experiences and the teacher-student interplay in

primary schools from the teachers' standpoint, drawing on multiple reporters and time points, the thesis provides valuable considerations for schools and policymakers in supporting teachers and students in the classroom to create a positive school environment.

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LIST OF ABBREVIATIONS

CI	Credible Interval
EMA	Ecological momentary assessment
ICC	Intraclass correlation coefficient
MCFA	Multilevel confirmatory factor analysis
MSEM	Multilevel structural equation modelling
NHST	Null Hypothesis Statistical Test
PPP	Posterior Predictive p-value
PSR	The Potential Scale Reduction value
SEM	Structural equation modelling
STRS	Student-Teacher Relationship Scale
SWLS	Satisfaction with Life Scale
TALIS	Teacher and Learning International Survey

CHAPTER 1. INTRODUCTION

This research aims to investigate the dynamics of teachers' emotional experiences and the interplay between teachers' and students' emotional experiences. Specifically, by focusing on teachers' emotional experiences, the study tests theoretical models. It discusses the cyclical relationship between momentary emotions and teachers' work-related and general well-being, the reciprocal relationships between teachers' and students' emotional experiences in class, and, further, the dyads between teachers and individual students (i.e., target students) in class. This chapter introduces the overall field and background for the research, presents the rationale and framework of this research, provides the connections among chapters and explains how these chapters contribute to the main aims of this thesis.

1.1 EMOTIONAL ASPECTS OF TEACHING

In recent years, with the attention on teacher stress, teachers' attrition rate, teaching effectiveness, and student outcomes (Duckworth et al., 2009; Pillay et al., 2005), the theme of teachers' well-being has been attracting attention. Given that it is highly plausible that a happy teacher is a key to having happy students and a better culture in the school (Harding et al., 2019; Roffey, 2012), it is crucial to focus on teacher well-being by investigating their experiences in school contexts.

In essence, teaching is more than a purely cognitive process focusing on passing knowledge and skills to students. The emotional dimension of teaching is often seen as the core of teaching, and teaching itself is seen as an emotional practice (Hargreaves, 1998). The teaching career requires emotional dimensions such as passion and enthusiasm, and the teaching process involves relationship-building, caring and emotional understanding (Bullough & Hall-Kenyon, 2012; Hargreaves, 2000).

Teachers experience a wide range of emotions as part of their daily lives with students (e.g., Hargreaves, 2000; Prosen et al., 2011; Zembylas, 2004). For example, a teacher may feel angry when students chatter loudly in the classroom and feel happy when students make huge progress. Across their teaching career, teachers face various student issues that may challenge them emotionally and physically. However, these experiences can, in turn, give them a sense of achievement. For example, teacher stress and exhaustion have been important topics in research on teaching for a long time. At the same time, teachers feel content when they have satisfying relationships with students or if students perform well in the classroom (e.g., Prosen et al., 2011; Taxer et al., 2019). These two conditions may seem contradictory at first glance. However, this is what a teacher's teaching career can look like: feeling exhausted but happy simultaneously.

The emotional aspect of teaching goes beyond addressing teachers' better emotional management or emotional intelligence. Teachers and students inescapably experience a wide range of emotions (e.g., enjoyment, anxiety, and anger) while teaching, learning, and interacting in the same classroom. It is necessary to investigate teachers' emotional experiences in classrooms to understand where their emotions come from and what the effects of specific emotions are (Hargreaves, 2001). However, the emotional aspects of teaching have long been understudied, especially teachers' emotional experiences in the classroom (Keller, Frenzel, et al., 2014; Meyer & Turner, 2007).

Various constructs related to the emotional aspect of teaching, such as emotions, occupational well-being, subjective well-being, burnout, and exhaustion were assumed to be connected and reflect a broader teacher well-being issue. Yet, these phenomena and constructs have seldom been incorporated and united in the research on teachers' emotional experiences (Frenzel, 2014), specifically considering the real-time emotional experiences in classrooms. In addition, the mechanism of how teachers' emotional experiences reciprocally interact with student experiences and behaviour remains unclear. To fill this gap, this thesis addresses the emotional aspect of teaching by focusing on emotional experiences in real-time classrooms.

1.2 DEFINING EMOTIONAL EXPERIENCES IN THE TEACHER WELL-BEING CONTEXT

In this research, the emotional experiences of teachers and students are defined in a broader context of teacher well-being. Teacher well-being, widely used as an umbrella term, refers to teachers' professional fulfilment and happiness (Acton & Glasgow, 2015). In the existing body of research, teacher and student well-being have mostly been used to indicate constructs that are substantively involved with emotional aspects such as satisfaction (e.g., Nalipay et al., 2019), burnout (e.g., Gluschkoff et al., 2016), and affect (e.g., Harding et al., 2019).

In the long history of human beings across different cultures, happiness and well-being are concepts that have been widely debated, discussed, desired and pursued (Nettle, 2005). Interestingly, emotional experiences are seen as a necessary component of the teacher well-being concept. The concept of *teacher well-being* is defined as containing three main dimensions: (1) teachers' general evaluation of life, (2) domain-specific (i.e., work-related well-being), and (3) emotional experiences in their lives (Diener et al., 2017). As Nettle (2005) stated, the happiness of human beings includes three levels, from individuals' momentary emotional experiences (momentary feelings, e.g., joy, pleasure), judgements about feelings (e.g., satisfaction/well-being), to quality

of life (e.g., flourishing and fulfilment). The first two levels are firmly bound to the general meaning of happiness or well-being and play an important role in contributing to a happy and positive school climate (Nettle, 2005). Taken together, to have a relatively comprehensive understanding of teacher well-being theme, momentary emotional experiences, work-related well-being, and general well-being are essential elements in a cyclical process.

Individuals' momentary emotional experiences appear to be more immediate, sensual, absolute, and measurable and to share relatively more commonality across cultures. Importantly, emotional experiences (both positive emotions and negative emotions) are the basis of individuals' long-term evaluations of the balance between their positive emotions and negative emotions. In this sense, the momentary emotional experiences of teachers could be seen as a part of their well-being, and the relationships between teachers' momentary emotional experiences and their subjective evaluation of happiness are involved with teachers' cognition and perceptions.

In this vein, the term emotional experience, as a part of teacher well-being in a broader sense, addresses the momentary situations experienced by a person in school settings (Nogueira, 2014). For teachers, emotional experiences in school settings are related to their teaching and instruction. For students, these emotional experiences are

related to their learning, including the activities and outcomes (Pekrun, 2006; Pekrun et al., 2002).

1.3 THE FOCUS OF THIS THESIS

The main focus of this thesis is to examine the role of teachers' emotional experiences in the primary school classroom and the interplay between teachers and students. In this thesis, emotional experiences are defined as a wide array of emotions teachers or students experience while teaching and learning in real-time academic settings and address the dynamic and dialectic nature of this process. In particular, a scope that addresses both positive and negative indicators was adopted in this thesis.

An important aspect of this thesis is the focus on identifying the student antecedents of teachers' momentary emotional experiences, the cyclical relationship between teachers' momentary emotional experiences and their well-being, and the reciprocal relationship between teachers' and students' emotional experiences in the classroom. Instead of addressing only negative indicators or positive indicators, this thesis uses a dialectical approach that addresses both positive and negative emotions. Positive and negative emotions are not a simple dichotomy but a complex balance. A large number of studies have addressed the negative factors or indicators of teacher emotions and well-being, such as teachers' levels of stress and teacher burnout (e.g.,

Aloe et al., 2014; Burić, 2019). Positive Psychology, which is dedicated to the scientific research of 'what makes life most worth living' (Peterson et al., 2008; Seligman & Csikszentmihalyi, 2000), shifted researchers' attention to individuals' happiness, addressing positive emotional experiences and strengths (Seligman & Csikszentmihalyi, 2000). Going beyond the aspect of Positive Psychology that mainly addresses the positive quality of a person, it is essential to understand the dialectical nature of teachers' emotional experiences in which positive and negative aspects of living are co-present and even co-dependent (Lomas & Ivtzan, 2016). In doing so, this thesis addresses both positive and negative emotional experiences in the real-time classroom.

This thesis focuses on emotional experiences in primary schools. Primary schools are a context for unique interaction for both teachers and students. Compared to secondary schools, primary school classrooms are a centre of greater emotional intensity where teachers and students have significant emotional and physical closeness (Hargreaves, 2000; Prosen et al., 2011). Teachers are expected to provide more warmth and care to students. On the other hand, the negative feelings could also be stronger due to these bonds and also the larger age differences between teachers and students than in secondary schools. Additionally, primary school teachers devote a large amount of time to the same group of students. To date, relatively more research on teachers' momentary

emotional experiences has been conducted in secondary school settings (e.g., Becker et al., 2014, 2015; Goetz et al., 2020; Keller, Frenzel, et al., 2014; Poon et al., 2019; Tam et al., 2019). This thesis, however, focuses on teachers' emotional experiences and their reciprocal relationships with Taiwanese primary school students. The specific study context is discussed in the next section (section 1.4).

1.4 Context of this study

This research focuses on teachers' emotional experiences within the scope of teacher well-being in Taiwanese primary schools. Taiwan's educational system provides a teaching context where the issue of teachers' emotions and well-being may be relatively less noticeable and explicit. This is mainly because the turnover rate cannot reflect teachers' needs due to the competitive nature of becoming a tenure-track teacher in public schools and its corresponding guaranteed position and teacher pension scheme (Thomas & Xu, 2022). Overall, job security, including an attractive remuneration and benefits package provided by the government, and the corresponding higher status of teachers, have been enticing people to join the teaching workforce (H.-J. Li, 2013). Nowadays, teaching as a career choice is not as popular as it used to be, but securing a permanent teaching position is still highly competitive.

Primary school education in Taiwan, a part of the compulsory education programme, begins at age 6 and continues until age 12, comprising six-year groups. Teaching positions in primary school include homeroom teachers, subject teachers, and administrative teachers. The primary responsibility of homeroom teachers is to teach a wide range of subjects to the same class, such as Mandarin, mathematics, and Integrative Activities[1] (H.-L. S. Chen & Huang, 2017), communicate with parents, deal with everyday matters, and provide leadership and pastoral care for their students. Subject teachers teach various classes in their specialist subjects, such as English, art or music. Administrative teachers spend most of their time on administrative work and contribute a small portion of their time to teaching. Generally, homeroom teachers teach 16 lessons per week, and subject teachers teach 20 lessons per week (Lin & Chiu, 2017). Practically, the exact subjects and lessons of primary school homeroom teachers may differ slightly based on the policies of local governments or schools. For example, homeroom teachers in Taipei City are expected to teach 15 lessons per week, while homeroom teachers in New Taipei City teach 16 lessons per week. Thus, primary

[1] Integrative Activities as a subject in schools aim to address students' life experiences and develop students' capability for life practice. The content of Integrative Activities is linked with different subjects to integrate students' experiences. It addresses cultivating students' competency in three main domains: self- and career development, life management and innovation, and social and environmental care (Ministry of Education, 2018).

school homeroom teachers are most likely to have continuous emotional interactions and build relationships with the same group of students.

Taiwanese society values education and has high expectations of teachers' roles. Taiwanese culture is influenced by several philosophical systems, including Confucianism, Taoism, and Buddhism (Pan & Yu, 1999). Specifically, Confucianism is embedded in education in Taiwan due to its history with education and the values addressed. It addresses interpersonal relationships and harmony, responsibility, and specific societal roles. Stemming from Confucianism, teachers are expected not only to impart professional knowledge and guide students to solve problems but also to be role models who provide insight to students. In this vein, teachers in primary schools are expected to look after all students and be role models while helping children to succeed.

The issue of teacher emotion and well-being in Taiwan seems to be a hidden problem waiting to be investigated from teachers' perspectives. Although teaching is increasingly portrayed as a stressful profession, the importance of teachers' emotional experiences could be overlooked due to Taiwan's relatively low teacher turnover rate. However, there has been a rising tendency in the number of self-harm or suicide cases among teachers over the last few years, and in most years, the most significant number of cases happened in primary schools (Campus Security Report Center, 2017, 2018,

2019). The results of TALIS 2018 (Teacher and Learning International Survey) of OECD (The Organisation for Economic Co-operation and Development) indicated that more than half of the primary school teachers in Taiwan have considered choosing another profession which is higher than the average among various nations (e.g., Netherlands, England, Denmark, France, Korea, Japan); in addition, more than 20% of Taiwanese primary school teachers have experienced a significant amount of stress (OECD, 2020). Over 10% feel their mental health and physical health are being impacted substantially by their teaching work (OECD, 2020). This implies the need to highlight awareness of teachers' emotions and well-being in educational settings.

One central aspect of work stress for Taiwanese teachers is their interactions with students. Previous research pointed out that primary school teachers experience the most significant proportion of discipline conflict in class. A study investigating 203 Taiwanese teachers shows that more than 25% of primary school teachers feel at least very stressed, and more than 40% of the teachers feel stressed to extremely stressed about students' disruptive behaviour (Kyriacou & Chien, 2004). A recent survey based on the TALIS 2018 has also indicated that Taiwanese primary school teachers' stress primarily originates from several factors, including parental concerns, classroom management, the workload of preparing lessons, and student intimidation and

humiliation (Chang, 2021). Therefore, it is essential to pay attention to the issue of teachers' emotions and well-being.

1.5 Research rationale and aims

This research focuses on understanding teachers' momentary emotional experiences in primary school classrooms in Taiwan and aims to investigate the dynamics of teachers' emotional experiences and the interplay between teachers and students in class. In doing so, the overarching aims were unpacked to explore: (1) teachers' momentary emotional experiences, their perceptions of student antecedents, day-to-day work-related well-being to their general well-being as a whole, (2) emotional contagion and its directionality between primary school teachers and students across lessons, (3) associations between perceived individual students' engagement and teachers' emotional experiences in teacher-student dyad between teachers and target students.

1.6 Contribution of the thesis

Through exploring teachers' emotional experiences by linking their momentary emotional experiences and their work-related and general well-being, as well as the interplay between teachers and students, this research contributes to the existing literature on emotional experiences and well-being in school settings by using an intraindividual approach. There are some precedents for the use of a momentary process

to explore teachers' emotions in class (Becker et al., 2014, 2015; Carson et al., 2010; Keller, Frenzel, et al., 2014), but investigating the process of teachers' emotional experience and the reciprocal interplay between teachers and students is relatively rare.

Additionally, by exploring teachers' and students' emotional experiences in school settings via a momentary approach, this thesis contributes to the understanding of emotional experiences in primary schools in Taiwan. To date, few studies have focused on academic emotions in Taiwan (e.g., Chang & Cherng, 2017; Lai & Wu, 2019). These studies mainly focus on students' emotions using an interpersonal approach. To the best of my knowledge, no study in Taiwan has combined teacher and student reports using an intraindividual approach.

Moreover, this research will contribute to policy on emotions and well-being issues in schools in Taiwan. The focus is to understand teachers' emotional experiences from the perspective of teachers as independent individuals who need support, and their well-being is not solely defined by how it could be beneficial to students. The findings also offer insights into how to boost students' positive emotions in school settings by improving teachers' emotional experiences based on their dynamic nature.

Furthermore, this thesis has the potential to generate insights into the role that some individual students play in influencing primary school teachers' real-time

emotions. The relationship of emotions and engagement between teachers and students can be utilised to understand whether teachers' situation-specific states are connected stronger with students with whom they are involved relatively more in class.

1.7 Structure of the thesis

This section outlines each chapter in the thesis and illustrates their links. Overall, the thesis consists of eight chapters. The first two chapters introduce the background and context. The third chapter outlines the research framework, the overarching research aims, and the corresponding research questions. The fourth chapter introduces the overall methodological approach. The following three chapters present three empirical manuscripts as the research findings. The last chapter integrates and synthesises the three empirical manuscripts' main findings and discusses the implications.

Chapter 1 Introduction

This chapter briefly introduces the thesis's background, research context, main focus, and purposes. Sections consist of an introduction to emotional aspects of teaching, emotional experiences in the well-being context, the focus of the thesis, the context of the research, the research aims, and an explanation of this work's contribution to knowledge. The last section of this chapter presents the structure of the thesis, explaining the contents of each chapter.

Chapter 2 Literature review

This chapter provides a critical approach to previous and concurrent research on teacher emotional experiences and reviews existing methodological approaches. As the main focus of this research draws on teachers' emotional experiences in school settings, particular attention is given to the conceptualisation of teachers' emotional experiences and relevant measurements. A discussion follows of the theories and theoretical models that informed the conceptual framework for the present research. Then empirical research concerning the effects and factors of teachers' emotional experiences in the classroom is presented. The gaps and the perspective adopted are highlighted to conclude this chapter.

Chapter 3 Research aims and questions

This chapter proposes the overall research framework and presents the overarching aims and corresponding research questions guiding the studies. It shows the conceptual model this research proposes to understand the dynamics of teacher emotional experiences for the thesis, followed by the justification and explanation of key paths in the proposed model. The model develops the existing model of teacher emotional experiences and considers the interplay between teachers and students. The chapter then

posits three overarching aims of the thesis and the research questions, which are connected to the three studies (manuscripts) presented in this thesis.

Chapter 4 Methodology

This chapter presents the overall research design and methodological approach of the present research. It begins with a brief introduction of the research design (micro-longitudinal design) and then a discussion of the pilot studies. The chapter proceeds with a discussion of data collection processes, such as sampling, sample characteristics, and research procedure, alongside a discussion of the ethical considerations. It then presents the measures used in the three studies and the quality of the research with the reliability and validity of the measurements. The chapter concludes with a description of the analytical approach applied in the three manuscripts of the thesis, with a summary of the chapter.

Chapter 5 Study 1

This chapter presents the first manuscript of this thesis (Study 1). It uses multilevel structural equation modelling (MSEM) to investigate the situational and daily factors that predict teacher academic emotions during lessons and the association between teacher lesson-specific emotions and their well-being. Teachers' perceptions of students' disruptive behaviour mainly predict their negative emotions, and teachers' perceptions

of student engagement predict both positive and negative emotions. The findings highlight the importance of teachers' lesson-specific emotions as they predict teachers' daily work-related and general well-being.

Chapter 6 Study 2

This chapter presents the second manuscript (Study 2). Connecting to the aims and research questions of Study 2, this manuscript uses MSEM to explore the interplay between teachers' and students' emotional experiences by examining teachers' self-report emotions, students' self-report emotions, and students' perceptions of teachers' emotions. Based on emotional contagion theory, the manuscript includes a discussion of the theory and background, then a description of research questions and methods. Lagged within-lesson variables are fixed to the model to investigate the effect of teachers' momentary emotions on students' momentary emotions and vice versa. The findings indicate the relationship between teacher emotion, student emotion, and student-perceived teacher emotion in Taiwanese primary school classrooms.

Chapter 7 Study 3

This chapter presents the third manuscript (Study 3), which uses MSEM to examine the dyadic relationship between teachers and individual students. To investigate the role of target students in teachers' emotional experiences in class, teachers' perceptions of four

target students' data regarding student engagement and teachers' emotional experiences during lessons are used, as well as teacher-reported teacher-student relationships. The findings highlight the vital role of teacher involvement in the effect of teacher-perceived individual students' engagement on teachers' emotions.

Chapter 8 Discussion and conclusion

This final chapter of the thesis integrates and summarises the main findings from the three studies (Studies 1 to 3, presented in Chapters 5 to 7), alongside an overall discussion of the findings. It then presents a discussion of general strengths and limitations. Then, directions for future research are presented and explained. Theoretical and practical implications are provided based on the findings and existing literature. The last section of this chapter provides the key conclusion of the research.

CHAPTER 2. LITERATURE REVIEW

2.1 CHAPTER INTRODUCTION

This chapter provides an overarching view of key theories and empirical models to clarify the research background and connections of the three studies presented in this thesis. The perspective and the overall research framework of teachers' emotional experiences are based on the theories and hypothetical models that underlie the role of teachers' emotional experiences. An independent introduction with a literature review is included for each study.

This chapter starts with an overall introduction to the central concept of this research in section 2.2, namely emotional experiences. Section 2.3 describes three theories that guide and form the basis of this research. In section 2.4, two previous hypothetical models that informed this research are briefly introduced and discussed. Section 2.5 then discusses the empirical research regarding the factors and effects of teachers' emotional experiences in the classroom. Finally, the chapter briefly presents the gaps in the literature and the perspective adopted in this research.

2.2 EMOTIONAL EXPERIENCE IN SCHOOLS

In this research, as the definition in Chapter 1, emotional experiences are viewed as the first level of well-being (happiness) that may shape teachers' work-related daily well-

being and general well-being. This section will discuss the meaning of emotions in academic literature and research related to the concepts and dimensions of emotions.

2.2.1 Conceptualisation of teacher emotion

The conceptualisation of emotion in scientific research is challenging because the concept of emotion is often confused with other terms, such as mood and feelings (Beedie et al., 2011; Scherer, 2005). Although people often talk interchangeably about emotion and other affect phenomena (e.g., mood, affect, attitude) in their daily lives, emotion can be distinguished from other affect phenomena in several ways in scientific research.

Several features or potential criteria are used to distinguish emotions from other terms: (1) emotions are event-focused, that is, emotions are anchored in specific stimuli/events, (2) emotions are appraisal driven, that is, the event has its significance to an individual's concern. (3) emotions have response synchronisation. Since emotions are event-focused, the same pattern of appraisals corresponds to a similar response pattern. (4) emotions can change rapidly. Due to changing events and situations, emotions can change rapidly to adjust to the circumstances. (5) emotions have a substantial effect on corresponding behaviour (emotion-consequence behaviour), which can get in the way of the original plans or ongoing behaviour. (6) emotions have a

relatively short duration, and (7) the intensity of the response and the emotional experiences are relatively high (Beedie et al., 2005, 2011; Scherer, 2005). For example, the duration of mood is longer, but the event-focused level is low. In addition, it is related to the supply and demand of our internal resources and outward requirements, while emotion, a process containing psychological and physiological components, is triggered by stimulus events like natural phenomena or behaviour (Pekrun, 2006; Scherer, 2005). That is, emotion is a kind of situation-specific mental state which is intense and happens quickly with a multidimensional nature. Specifically, it comprises subjective experiences and objective responses, including cognitive components (e.g., appraisal), psychophysiological responses (e.g., autonomous nervous system, ANS), and the expression of behaviours (e.g., facial expressions), and subjective feeling components (Kreibig, 2010; Scherer, 2005).

Individuals may experience various patterns of a combination of emotions in different situations. In school settings, teachers' and students' emotions are mainly related to their academic activities, instructions, achievements, and outcomes, which can be called *academic emotions* (Pekrun et al., 2002). Initially used for students, academic emotions refer to the emotion students experience when attending class, taking tests, and studying (Pekrun et al., 2002). However, academic emotions also apply

to teachers and other educators in school settings (Pekrun et al., 2007). As the emotions teachers experience when interacting with students and teaching in an academic setting play an important role, some researchers have applied the concept of academic emotions in teacher emotions studies (e.g., Chang & Cherng, 2017; Cubukcu, 2013).

The primary focus of this thesis is to investigate teachers' emotional experiences in the classroom. In this work, emotional experience refers to emotions experienced by teachers or students that are tied to academic settings and are momentary occurrences in a given situation (Pekrun, 2006).

2.2.2 Teacher emotional experiences in the classroom

In the history of emotion research, emotions have usually been studied from two perspectives: Discrete emotions and dimensional emotions. The discrete emotion perspective assumes that each emotion has its distinctive response (experiential, physiological, and behavioural) to the events or stimuli (Eteläpelto et al., 2018). For some researchers, several discrete emotions are basic and pancultural (Ekman, 1992). For example, anger, surprise, disgust, enjoyment, fear, and sadness are considered basic emotions that are universally experienced by individuals regardless of the differences in regions, languages, and cultures (Ekman, 1992; Izard, 2007). The dimensional aspect, on the other hand, postulates that emotions can be distinguished by two or more

fundamental dimensions. The two most common dimensions are valence (positive/negative) and arousal (or activation, high/low). The circumplex model states that people's emotional states are interrelated in a systematic fashion that occurs across cultures and languages (Russell et al., 1989). Evidence has identified a robust two-dimensional framework based on valence (positive and negative) to describe emotions at a general level, such as in the Positive and Negative Affect Scale (Watson et al., 1988; Watson & Tellegen, 1985).

Instead of being competitive or incompatible with each other, discrete emotions and dimensional frameworks could be compensatory to each other (Watson & Tellegen, 1985). The various evaluations of feelings regarding different individuals or situations are commonly related to valence, i.e., positive and negative (Harmon-Jones et al., 2017). In addition, discrete emotions categorised as positive emotions or negative emotions may share a common ability (e.g., broaden one's scope) in daily life (Fredrickson, 2001). Studies of teachers' emotional experiences have applied both discrete and dimensional approaches (Frenzel et al., 2021). To date, the most common discrete momentary emotions of teachers that have been identified and studied are enjoyment, anger, and anxiety (e.g., Becker et al., 2015; Frenzel et al., 2015; Keller, Chang, et al., 2014). Evidence also indicates that teachers experience various positive

and negative emotions such as pride, contentment, surprise, disappointment, boredom, fear, sadness, guilt, and shame (e.g., Carson, 2007; Goetz, Frenzel, Lüdtke, et al., 2010).

Pekrun's (2006) control-value theory of achievement emotions characterises different types of emotions experienced in academic settings. The theory distinguishes two types of emotions in school settings based on the object focus: outcome emotions and activity-related emotions. Outcome emotions include hope, hopelessness, and anxiety that indicate reactions to the academic outcome pertaining to success or failure. They can further be characterised as prospective (concerning anticipated success or failure) and retrospective (concerning past success or failure) outcome emotions. Activity-related emotions, such as enjoyment, relaxation, anger, and boredom, pertain to emotions elicited by action in activities rather than outcomes. For instance, a teacher may feel enjoyment when the class is controllable and engaged. The outcome emotions and activity-related emotions can further be categorised by valence (positive to negative/ pleasure to displeasure) and activation level (high activating and low activating) into four dimensions: positive activating (e.g., enjoyment, hope, pride), positive deactivating (relaxation, contentment, relief), negative activating (anger, frustration, anxiety, shame) negative deactivating (e.g., boredom, disappointment, sadness, hopelessness). Interestingly, during the lessons, primary school teachers and

students may experience various emotions, including outcome emotions and activity emotions, as when they engage in teaching and learning activities, they continuously evaluate their formative teaching or learning outcomes.

2.2.3 Measuring teacher emotional experiences

Subjective experiences of emotion are mainly measured by self-report methods such as interviews or questionnaires. Naturally, there are other measures, such as facial expressions and autonomous nervous systems, which emphasise finding relatively objective and nomothetic evidence (e.g., Ekman, 2016; Kreibig, 2010); however, these measures cannot provide the exact feelings of individuals. Pekrun (2016) pointed out that self-report is indispensable to understand the subtle aspects of human emotions and the process of emotional experiences. First, an emotion is a subjective experience, and individuals are able to report their own emotions. Second, a self-report allows researchers to assess different components of emotions. Moreover, it is more economical, particularly in educational settings. Although self-report measurement is unlikely to capture the unconscious emotions of individuals (Pekrun et al., 2011), it is still one of the most useful ways to explore human emotions and thus is suitable for different types of individual psychological processes (Pekrun, 2020).

One important issue related to traditional self-reports of emotions, especially momentary emotional experiences (i.e., state emotions), is retrospective bias (Carson et al., 2010; Schwarz, 2012). However, the distortion originating from retrospective reports can be minimised by using a data collection design that frequently collects momentary data (e.g., behaviour or psychological states). Ecological momentary assessment (EMA), incorporating a wide range of pre-existing methodology traditions and methods that are rooted in different disciplines based on real-time and real-world data, allows researchers to minimise the retrospective bias of self-report data, consider ecological validity, and capture the dynamics over time (Shiffman et al., 2008). These pre-existing methods are from diverse traditions or disciplines (Stone et al., 2007), including diaries (Bolger et al., 2003), behavioural observation, self-monitoring (behaviour-based, Korotitsch & Nelson-Gray, 1999), time budget studies, experience sampling methods (ESM, random time sampling. Csikszentmihalyi & Larson, 1987; Larson & Csikszentmihalyi, 1983), and ambulatory monitoring (e.g., cardiovascular or physiological monitoring, Fahrenberg & Myrtek, 1996). For example, one increasingly popular choice among these traditions to understand people's everyday lives is the experience sampling method. It records individuals' feelings at a random or prescheduled time based on signals.

The key characteristics of EMA include: (1) the use of momentary and real-time assessment, (2) assessments involving a large number of repeated measures, and (3) assessments that are performed as they occur (Shiffman et al., 2008; Stone et al., 2007). EMA is relatively flexible because it can combine different designs (e.g., event-based and time-based designs) and can incorporate various devices (e.g., paper-and-pencil, PDA, mobile phones, tablets) to measure momentary responses.

To date, ecological momentary assessment (including the experience sampling method) has been used to investigate students' and teachers' real-time emotional experiences in educational settings (e.g., Becker et al., 2015; Carson et al., 2010; Goetz et al., 2010; Keller et al., 2014; Poon et al., 2019; Simbula, 2010; Tam et al., 2019). Evidence from the research that uses ecological momentary assessment, specifically the experience sampling method, found that teachers' emotions are shown to be relatively situation-specific in two-level models (Becker et al., 2015; Frenzel et al., 2020; Keller, Chang, et al., 2014). For example, Keller et al. (2014) found that teachers' anxiety (ICC, intraclass correlation coefficient at the between-teacher level = 0.19), enjoyment (ICC = 0.23 at the between-teacher level), and anger (ICC = 0.20 at the between-teacher level) tend to be situation-specific with higher variance occurring within teachers across lessons. Similarly, Frenzel et al. (2020) also found that teachers' enjoyment, anger, and

anxiety are situation-specific (e.g., ICC of enjoyment = 0.07, anger = 0.14, anxiety = 0.13 at the between-teacher level). Interestingly, the patterns of the ICCs of enjoyment, anger, and anxiety are different in these studies. The first study shows that enjoyment as a type of positive emotion has a relatively higher variance at the between-teacher level, but the second one found the opposite. It is worth noting that there might be cultural differences in some aspects of emotions (e.g., arousal), which could lead to discrepancies in findings (Lim, 2016). Overall, these findings provided insight into the field and confirmed the feasibility of using ecological momentary assessment to collect self-reported emotional experiences of teachers and students.

2.3 THEORIES LEADING TO THE RESEARCH

This section introduces theoretical perspectives that guide this research to understand the role of teachers' emotional experiences. This is by no means an exhaustive overview of theories that contribute to the teacher emotional experience field, as various theories have been applied by previous researchers, such as the physiological theories (e.g., the Cannon-Bard Theory), the application of attribution theory of emotions (e.g., Graham & Weiner, 1986), or the application of self-determination theory (Deci & Ryan, 2000). Instead, this section presents three theories that informed the current research. This section commences with an introduction and explanation of the broaden-and-build

theory. The broaden-and-build theory, which stemmed from a positive psychology approach, proposes a theoretical framework that brings together the other theories and addresses the underlying mechanism of the teacher's emotional experience and well-being. Next, appraisal theory is discussed and incorporated with the broaden-and-build theory. Then, the theory of emotional contagion is discussed. This section concludes with a summary to synthesise and integrate the theories that informed this research.

2.3.1 Broaden-and-build theory

Negative emotions have long been studied and identified with differentiated categories. Relatively, positive emotions have gained less empirical attention and are less differentiated (Fredrickson, 1998). The broaden-and-build theory of positive emotions (Fredrickson, 2001) proposes the different functions of positive and negative emotions in an individual's daily life. Unlike discrete negative emotions, which can often be connected to specific action tendencies (e.g., anger is linked to attack) as reactions to life-threatening situations, the link between positive emotions and specific action tendencies is vague. In other words, positive emotions have been seen to have less distinctive signals than negative emotions, making positive emotions challenging to specify (Ekman, 1992). However, based on the broaden-and-built theory, positive

emotions, such as enjoyment and pride, share a common function in broadening people's thought-action repertoires.

The broaden-and-build theory posits that although themes that appraise the feeling of positive emotions may be less distinctive compared to those that trigger negative emotions, positive emotions have their appraisals, such as feeling safe or experiencing a good surprise (Fredrickson, 2013a). Positive emotions then broaden people's thought-action repertories and build individuals' resources (e.g., skills, knowledge, motivations, and resilience to adversity). Thus, individuals with positive emotions could have a more holistic scope toward a situation and have higher attentional flexibility. Evidence from experimental studies supports the assumption that positive emotions broaden individuals' breadth of attention and scope. For instance, in an experiment, Rowe (2007) found that inducing positive emotions in university students (happy group compared to neutral and sad groups) widened their scope of attentional selection to both external visual and internal conceptual space. In addition, a brain imaging study indicated that positive emotions increase the perceptual encoding and negative emotions decrease it, showing that positive emotions enhance novel behaviour tendencies and negative emotions are related to stereotyped reflexes (T. W. Schmitz et al., 2009).

Intriguingly, positive and negative emotions have two self-perpetuating systems but are interwoven. Over time, positive emotions urge people to develop and accumulate individual resources that lead to upward spirals (Fredrickson, 2001, 2003). A daily accumulation of positive emotions leads to increased personal resilience and life satisfaction (Cohn et al., 2009). Positive emotions then form an upward spiral, a cycle that leads to a flourishing life. By contrast, over time, negative emotions may trigger a downward spiral that leads to narrowed self-focus and defensive behaviour (Garland et al., 2010). Experimental studies support that the accumulation of positive emotions triggers an upward spiral inside the self-sustaining system by building individuals' resources, such as coping strategies, mindfulness, and perceptions of social connections, that further lead to well-being, such as physical health and life satisfaction (e.g., Catalino & Fredrickson, 2011; Fredrickson et al., 2008; Fredrickson & Joiner, 2002; Kok et al., 2013). For example, Fredrickson et al. (2008) found that meditation practice (intervention) increased working adults' positive experiences. In turn, their positive experiences increased individuals' resources (e.g., mindfulness, social support, and fewer illness symptoms), which then predicted individuals' higher life satisfaction and lower levels of depression.

Based on Fredrickson (2001), positive emotions share some common functions (e.g., broadening individuals' scope and building personal resources). Both high-activation positive emotions (e.g., joy) and low-activation positive emotions (e.g., contentment) could play a role in producing a broader momentary thought-action repertoire. Additionally, although the link between certain negative emotions and functions is relatively obvious, these emotions may share a common function to produce a narrower momentary thought-action repertoire. Evidence also indicated that positive emotions might 'undo' the lingering effect that is triggered by negative emotions. Fredrickson et al. (2000) found that university students' cardiovascular reactivity to the elicited anxiety of speech preparation recovered faster after viewing an amusement or contentment film clip than other groups (i.e., neutral film clip group and sad film clip group). In this sense, the role of positive emotional experience is both a facilitator and a protector.

Overall, the broaden-and-build theory provides insight into teachers' and students' emotional experiences in school settings. Based on the broaden-and-build theory, continuously building positive emotional experiences in the classroom could reciprocally facilitate more positive emotions, broader thinking, and positive meaning. Additionally, accumulating positive emotions could help people build their

psychological resilience, facilitate coping with adversity, and enhance emotional well-being (Fredrickson & Joiner, 2002). This implies the positive aspect and active meaning of investigating emotional experiences in school settings: understanding the momentary emotional dynamics could help find ways to support teachers and further support their students.

2.3.2 Appraisal theory

Appraisal theory complements the antecedent part of individuals' emotional experiences. Appraisal, an evaluation or a judgement of the importance of an event that precedes emotions, reflects the person-environment relationship (Lazarus, 1991). Based on appraisal theory, emotions derive from individuals' perceptions of situations that are relevant to their well-being, such as their goals, needs, and concerns (Ellsworth, 2013; Lazarus, 2001; Roseman & Smith, 2001). In turn, emotional experiences could impact individuals' appraisal in evaluating an event they face.

The core of appraisal theory emphasises the perceptions or evaluations of an individual. Instead of events themselves, the individual interpretation matters (Roseman & Smith, 2001). In other words, appraisal theory concerns the existence of individual differences when interpreting events (Scherer & Moors, 2019). Although the same appraisal patterns could generally evoke the same emotions, this is not the case for the

same event. Different individuals may have distinct interpretations, even though they face the same event, eliciting different emotions. In addition, at different times or under different situations, the same event could provoke discrepant emotions in the same individual (Roseman & Smith, 2001).

Although appraisal theory involves cognitive elements in explaining emotions and their precedence, it is worth noting that it assumes that emotions are elicited by current appraisals (Moors, 2014; Roseman & Smith, 2001). In most conditions, an appraisal is assumed to proceed without effort or explicit awareness of individuals (Lazarus, 2001). Strikingly, although appraisal itself is a cognitive process, it could arise both consciously and unconsciously. This matches the conflictual situation when a person rationally interprets a situation but also senses negative emotions.

In this vein, teacher and student emotions could reflect individual differences in the school setting. Teachers' and students' perceptions of the situations and dyadic relationships could lead to different emotional experiences in the classroom. This also implies that although some common events (e.g., students' behaviour) exist in the classroom, each teacher may have different emotional reactions to a similar event. Also, the same teacher may have distinct emotional experiences because the individual they interact with is different or at a different time.

In summary, empirical studies have applied appraisal theory to form a framework for investigating teachers' emotional experiences (e.g., Chang, 2009; Frenzel, 2014; Frenzel et al., 2020; Jacob et al., 2017). Appraisal theory makes up the understanding of individuals' subject interactions with their environment, reflecting on their emotions. It implies individual differences in reacting to a given event, different reactions of a person to a given event across various situations, and further the different emotional reactions to different individuals in a given event (M.-L. Chang & Davis, 2009).

2.3.3 Theory of emotional contagion

Teachers and students share the same classroom where they interact; whether their emotions affect each other is a crucial question. Emotional contagion is conceptualised as a relatively unconscious process in which one can 'copy' or 'catch' another individual's emotional state (Hatfield et al., 1994; Sullins, 1991).

Emotional contagion theory postulates that emotions can be transmitted from one person to another through mechanisms such as mimicry and feedback (Hatfield et al., 1993, 1994). Physiologically, one's emotional experience may be affected by direct and automatic mimicking and synchronising others' emotional states through the neurological system (Hatfield et al., 1994). In addition, emotional contagion can be

elicited through various feedback mechanisms, such as vocal expression, facial expression, postural expression, indirect human interactions, observations of others' behaviours, and self-perceptions of emotions based on the emotional states of others (Hatfield et al., 1993, 1994; Herrando & Constantinides, 2021).

A similar division of emotional contagion is emotional crossover. Crossover theory originated from the research on psychological stress between individuals (Westman, 2001; Westman et al., 2013). The most significant difference between the crossover theory of emotions and emotional contagion is that emotional contagion is a relatively momentary and unconscious process, while crossover addresses the conscious process based on an individual's empathic attitudes. It is plausible that emotion can be transmitted in different ways (Hatfield et al., 1993), including consciously and unconsciously.

Noticeably, based on the emotional contagion theory, emotions are not always contagious, and emotional contagion is more likely to be triggered under some specific situations. For example, individuals who are attentive to others' emotions, invest more, or define themselves based on their interrelationships with others, are more likely to catch others' emotions (Hatfield et al., 2014). Thus, people in some cultures may be more vulnerable to contagion than those in other cultures due to different perspectives

on interpersonal relationships. Furthermore, individuals may have different levels of ability to read others' emotional expressions, various tendencies to mimic others' expressions, and diverse emotional reaction levels. Thus, it is essential to study individual differences in emotional contagion (Hatfield et al., 1994).

Overall, emotional contagion is a phenomenon that could exist between individuals from moment to moment, which also occurs in groups (Barsade, 2002). Some relationships involving intimacy, psychological investment, or power/control (e.g., couples, parent-child, psychotherapists-client, teacher-student) are more prone to contagion (Hatfield et al., 1994; Hsee et al., 1990). This indicates that emotional contagion between teachers and students may be reciprocal and complicated. On the one hand, teachers' psychological investment and attention paid could make them more likely to catch students' emotions. On the other hand, students are more likely to catch teachers' emotions because teachers have higher levels of power and control in their relationships. Some empirical work has applied the emotional contagion theory (or crossover theory) to explore how teachers' certain discrete emotions are transmitted to their students (e.g., Bakker, 2005; Becker et al., 2014; Y.-F. Chang & Cherng, 2017; Frenzel et al., 2018; Frenzel, Goetz, Lüdtke, et al., 2009), which initiated further research on emotional contagion in school settings. Evidence has been established

regarding the transmission from teachers to students based on student reports (Becker et al., 2014; Y.-F. Chang & Cherng, 2017; Keller & Becker, 2021). For example, studies discovered that students' perceptions of teachers' enjoyment, anger, and anxiety are related to students' enjoyment, anger, and anxiety, respectively, in the classroom (Becker et al., 2014; Keller & Becker, 2021). However, the relationship between teacher-reported emotions and student emotions is less clear (Keller & Becker, 2021). Further empirical studies regarding emotional contagion between teachers and students will be discussed in section 2.5.4.

2.3.4 Summary

This section introduces and explains three theories related to emotional experiences informing the current research. The broaden-and-build theory carves out the overall approach of this research. It provides a more balanced and holistic view of emotions concerning the development and well-being of people. Although addressing more on the meaning and function of positive emotions, it also provides the meaning of negative emotional experiences and how they are interwoven.

Appraisal theory and the emotional contagion theory are also consistent with the broaden-and-build theory. In consonance with the appraisal theory, the broaden-and-build theory suggests that the appraisal process precedes a cascade of emotional

responses. Appraisal theory rounds off the process of positive and negative emotional experiences by addressing the antecedents of emotions. Furthermore, emotional contagion can be combined with the broaden-and-build theory to explain the positive or negative emotional spillover in the interpersonal context (Westman et al., 2013). Positive emotions broaden one's thought-action repertoires, increase individuals' openness, and expand a person's interpersonal scope, which could lead to the transmission of positive emotions (Conway et al., 2012).

To summarise, the broaden-and-build theory combined with the appraisal theory and emotional contagion theory together implies that emotions are a process, in which positive and negative emotions may have different pathways but also interact with each other to impact an individual's overall development and well-being. This provides significant insight into understanding teachers' emotions in the classroom and their personal lives and how teachers' emotional experiences intersect with students' emotional experiences.

2.4 Reciprocal cycle of teachers' emotional experiences

Teachers' emotional experiences have been assumed to be a potential bridge between classroom antecedents and their work-related or general well-being. This section draws on two theoretical models regarding teachers' emotional experiences to discuss the

potential student antecedents in the classroom and the cyclical relationship of potential antecedents to teacher work-related and general well-being. These models and the theories discussed in the previous section together shed light on the current research.

2.4.1 Teacher emotional experiences and well-being

In this research, teachers' emotional experiences are defined in the context of well-being; that is, an individual's momentary emotional experiences represent the first level of well-being. However, it is worth noting that individuals' evaluation of their work and life is not simply adding positive emotional experiences or purely subtracting negative from positive emotional experiences (Diener et al., 2000). In this light, one aim of this research is to identify the relationship between teachers' momentary emotional experiences while teaching and their work-related and general well-being.

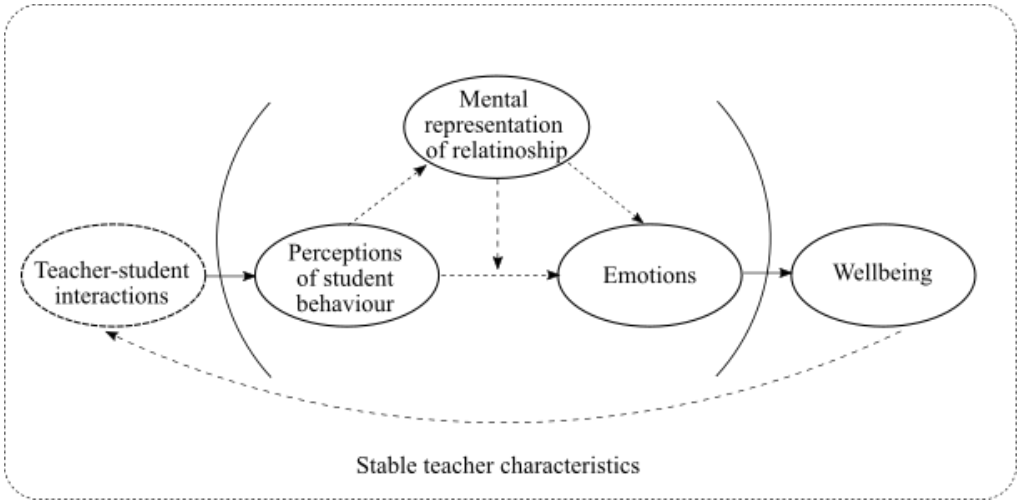
Two similar hypothetical models that underline the relationship between teachers' in-class emotional experiences and teachers' well-being were proposed by Chang (2009) and Spilt et al. (2011), respectively. Both models address teachers' perceptions in the teacher-student interaction context, and Chang's (2009) hypothetical model specifically indicates the link between teachers' negative emotional experiences and their work-related burnout. In a broader sense, Spilt and colleagues' (2011) model

points out the importance of teachers' emotional experiences in class (e.g., enjoyment, anger, anxiety) for teachers' general well-being.

The model of Spilt et al. (2011) shows that teachers' accumulation of emotional experiences could lead to well-being results regarding work (e.g., burnout, work engagement) or life (general well-being) in the interaction context (please see Figure 1). One prominent feature of the model of Spilt et al. (2011) is teachers' mental representation of the teacher-student relationship, which also reflects their perceptions and judgements of their relationship quality with students. The teachers' mental representation of teacher-student relationships may mediate or moderate the relationship between perceived student behaviour and teachers' emotional experiences.

Another feature of this hypothetical model is that it illustrates the appraisal process of teachers' emotional experiences (the middle part in the bracket in Figure 1). Teachers' everyday emotional experiences reflect the response of their perceptions of student behaviour from the teacher-student interaction context. Then, teachers' everyday emotional responses have an impact on their general well-being.

Figure 1 *Hypothetical model of teacher emotional experiences and well-being*



Note. This "Hypothetical model" regarding teacher well-being indicates the reciprocal relationship between variables and subjective appraisal. Adapted from "Teacher wellbeing: The importance of teacher-student relationships," by J. L. Spilt, Koomen, H. M. Y., and Thijs, J. T., 2011, *Educational Psychology Review, 23*, p.460 (https://doi.org/10.1007/s10648-011-9170-y). CC BY-NC.

Previous research on teacher well-being has used the hypothetical model by Spilt et al. (2011) to explore the relationship between student behaviour and teachers' well-being (Aldrup et al., 2018). Investigating teachers' perceptions of student misbehaviour, student-rated misbehaviour, and teachers' well-being in secondary schools, Aldrup et al. (2018) found that student misbehaviour led to a higher level of emotional exhaustion (β = 0.18, p = .02) and lower level of teachers' work enthusiasm (β = -0.15, p = .02) at a later stage in the longitudinal study. Furthermore, the teacher-student relationship mediates the relationship between perceived students' misbehaviour and teacher enthusiasm (indirect effect: β = -0.06, p = .01) but not the relationship

between perceived student misbehaviour and teacher exhaustion. Interestingly, Aldrup et al. (2018) further indicated that teachers' work-related well-being significantly correlates with their perception of students' misbehaviour but not with student-rated misbehaviour. This may imply that there are differences between teacher-rated and student-rated student behaviour. A possible explanation is that Aldrup et al. (2018) used the average data of all the students, while teachers are often interrupted and feel stressed when working with particular students in the class (Gagnon et al., 2019). That is, the performance of the whole classroom may not account for teachers' perception of students' misbehaviour, but some particular students may. Hence, it is important to consider teachers' interactions and relationships with individual students.

To date, the mechanism underlying the relationship between students' behaviours, teachers' emotional experiences, and teachers' well-being, according to the teacher-student relationship, has rarely been explored. This model mainly focuses on student misbehaviour and the cycle of the teacher's mental representation. Moreover, this model treats emotions as a daily production of judgement; however, emotions could be an immediate response to events or stimuli. In other words, teacher emotions are moment-to-moment responses to teacher-student interactions in class. At the same time,

teachers' feelings about relationships may also play an important role between momentary emotions and teachers' subjective well-being.

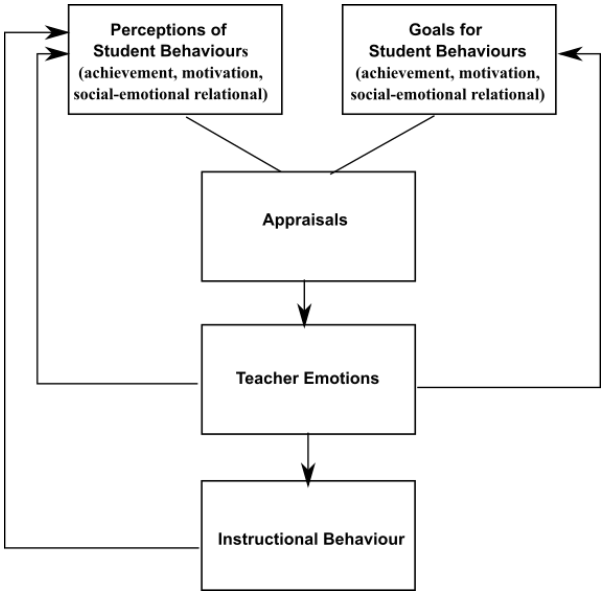
2.4.2 Student behaviour as antecedents of teachers' emotional experiences

As classrooms are a centre of interaction for both teachers and students, how teachers perceive students' behaviour and how this can be seen as a cue for teachers to evaluate their teaching is important. The reciprocal model on causes and effects of teacher emotions from Frenzel (2014) provides an integrative framework for understanding the antecedents and effects of teachers' emotional experiences in the classroom (see Figure 2). This model depicts the relationship between students' behaviour in the classroom, teacher emotions, and teachers' instructional behaviours based on appraisal theory and attribution theory.

One key feature of this model is that teachers' emotional experiences in the classroom are triggered by teachers' evaluation of the alignment between their classroom goals and students' behaviour in the classroom. Teachers evaluate the level of their goal achievement according to their perceptions of student behaviour at any specific time point during the process (e.g., during teaching, at the end of the lesson, and the end of the school year). The model specifies four themes that could guide teachers' goal settings and perceptions of students' behaviour. (1) cognitive theme:

pertains to students' competencies regarding a specific subject. (2) motivational theme: concerns students' motivational engagement in the classroom. (3) social-emotional theme: refers to students' ability to follow the rules and work in a group in the classroom, and (4) relational theme: concerns the relationship quality between teachers and students.

Figure 2 *Main concepts in Frenzel's reciprocal model of teacher emotions*



Note: This figure depicts the reciprocal model on causes and effects (Adapted from "Teacher emotions*"* by A. C. Frenzel, 2014, in E. A. Linnenbrink-Garcia & R. Pekrun (Eds.), *International handbook of emotions in education* (pp. 494-519). Routledge). This Figure is available at https://doi.org/10.6084/m9.figshare.14493789.v2, licensed under CC BY-NC-SA 4.0.

Past literature on teachers' emotional experiences has also adapted the reciprocal model on causes and effects as a framework to understand different relationships, such as the relationship between teacher emotions and self-efficacy (Burić et al., 2020), and

the relationships between teachers and students (Frenzel et al., 2018). The reciprocal model on causes and effects of teacher emotions provides insightful perspectives to study teachers' emotional experiences in the classroom, considering students' behaviour as factors or precursors. This model also addresses the dynamics of the forming of teachers' emotional experiences.

To summarise, the model addresses the reciprocal process of teacher emotions in the classroom. It expands the central part of Spilt et al.'s (2011) model (the path of perception of student behaviour to emotions) and strengthens the role of teachers' emotional experiences. It addresses teachers' discrete emotions resulting from their judgement based on whether their goals align with students' behaviours when interacting with them. Teachers' emotions could further affect their instructional behaviour. Frenzel's (2014) model implies that the links of teachers' emotions with student behaviour or their own behaviour in the classroom could be because of their judgements about the situations they face. Teachers experience positive emotions if their positive goals are aligned with the students' behaviour they perceive. However, this model focuses only on the teachers' judgements regarding their perceptions of student behaviour, but not the reciprocal relationship between teachers' and students' emotions in the classroom.

2.4.3 Summary

In summary, the model of Spilt et al. (2011) illustrates a process of teachers' emotional experiences and teacher well-being in the teacher-student interaction context and specifically addresses the role of teachers' perceptions of the teacher-student relationship with their students. There are several important implications of this model. First, aligned with the broaden-and-build theory, this model depicts a process from teachers' momentary emotional experiences to teacher well-being, especially the primary link to the change of positive and negative indicators of work-related well-being. Second, the model implies that teachers' perceptions regarding different individual students may lead to different reactions. It then addresses the dyadic nature of teachers and students. Third, the model addresses the link between student behaviour and teachers' daily emotional experiences, especially perceived student disruptive behaviour and teachers' negative emotions. However, the model does not specify the details of student behaviour that teachers experience in the classroom.

The reciprocal model on causes and effects sheds light on the types of student behaviour. As teachers' perception of student disruptive behaviour (social-emotional behaviour) is addressed more in the model of Spilt et al. (2011), a more active/positive indicator of perceived student behaviour, student engagement (motivational), is

addressed in the reciprocal model on causes and effects of teachers' emotional experiences. Both social-emotional and motivational behaviour (but not students' performance) were identified as playing an important role in teachers' enjoyment, anger, and anxiety (Frenzel, Goetz, Stephens, et al., 2009). Together with the theories discussed in the last section (section 2.3), this research aims to highlight the critical role of teachers' emotional experiences in the classroom interaction process (student behaviour, student emotions) and teacher well-being. Key links and concepts will be discussed in the next section (section 2.5).

2.5 Empirical research of teachers' emotional experiences

One approach to understanding teachers' emotional experience is focusing on the potential causes that elicit their emotions when they are with their students in the classrooms. Several aspects of teachers' emotional experiences in the classroom context were identified based on the theories and models discussed in the previous sections. First, student behaviour, specifically from teachers' perspectives considering both students in general and individual students, is an essential precursor to teachers' momentary emotional experiences in the classroom context. Second, the link between teachers' momentary positive and negative emotional experiences and teachers' well-being is identified. Third, the interaction loop of teacher and student emotions that

depicts the dynamics in the classroom is a crucial aspect. This section provides a brief review and concept explanation based on the aspects identified from theories and previous theoretical models.

To start, research regarding teachers' emotional experiences and student behaviour will be discussed. Following that, a discussion of the role of individual students in the classroom is provided. Then the link between teachers' momentary emotional experiences and the teachers' well-being will be presented. Last, the emotional contagion between teachers and students will be discussed.

2.5.1 Student behaviour as a precursor of teacher emotional experiences

One core element of the classroom process is the interaction between teachers and students. Researchers have depicted teachers' emotional experiences as including in-class emotions and well-being and indicated the importance of factors pertaining to teachers' perceptions of students in the classroom (Chang & Davis, 2009; Frenzel, 2014; Spilt et al., 2011). The hypothetical models in section 2.4 and their assumptions indicated the key roles of student behaviour and teachers' perceptions in understanding teachers' emotional experiences. This section addresses the real-time classroom interaction in the primary school. Specifically, it provides a brief review of the key

studies regarding the relationships between student behaviour (i.e., socio-emotional, motivational, and relational) and teachers' emotional experiences.

Student disruptive behaviour and student engagement

One important aspect contributing to teachers' emotional experience during the classroom process is student socio-emotional behaviour, which refers to whether students follow the classroom rules (Frenzel, 2014). In empirical research, this is usually studied as teachers' perceptions of students' disruptive behaviour, student misbehaviour, and classroom discipline (e.g., de Ruiter et al., 2020; Hagenauer et al., 2015). In the classroom, students' motivational behaviour, which means students' active involvement in the classroom that is interwoven with their socio-emotional behaviour, marks another significant aspect. In empirical studies, student motivational behaviour is often conceptualised and studied as students' engagement in the classroom (e.g., Hagenauer et al., 2015; Martin & Collie, 2019). In the momentary classroom, both students' socio-emotional and motivational behaviours are relatively observable and frequent; thus, this section will discuss these two student behaviours together.

Examining the theoretical model of Frenzel (2014), researchers have established that teachers' perceptions of students' socio-emotional and motivational behaviour are related to their emotions. Hagenauer et al. (2015) found that a lack of discipline in class

significantly predicts negative emotions such as anger (β = 0.29, p < .001) and anxiety (β = 0.54, p < .001) in teachers in secondary schools. In addition, higher perceived student engagement predicts higher levels of teacher enjoyment (β = 0.49, p < .001) but lower levels of anger (β = -0.30, p < .001) and anxiety (β = -0.28, p < .01). Working with 218 primary school teachers (Year 3 - Year 6), de Ruiter et al. (2019) indicated that higher levels of perceived target students' lack of discipline and hostility or aggression towards peers predict higher levels of teacher anger (discipline: β = 0.26, p < .01, hostility: β = 0.23, p < .01) and lower levels of teacher enjoyment (discipline: β = -0.22, p < .01, hostility: β = -0.26, p < .01). The same study found that higher teacher-perceived student engagement predicts higher teacher enjoyment (β = 0.25, p < .01) and lower teacher anger (β = -0.16, p < .01).

In a diary study of 39 teachers and their students (total number of lessons = 316, filled in the questionnaire in the last 5 min of each mathematics lesson), Becker et al. (2015) found that a higher level of secondary school students' self-reported social-emotional behaviour (= class discipline) predicts lower anger of teachers (β = -0.23, p < .01) when considering teachers' appraisal. In addition, students' motivational behaviour predicts higher teacher enjoyment (β = 0.22, p < .001) when considering teachers' appraisal. Similarly, in a diary study of 37 primary school teachers, de Ruiter

et al. (2020) asked teachers to recall and illustrate their workday in relation to two selected students (target students) that day. When teachers perceived an event with a target student as more positive, they also reported a higher intensity of enjoyment and lower anger and anxiety. Perceived past disruptive behaviour moderated teachers' perceptions of events and teacher enjoyment (B = -0.05, $p < .05$), anger (B = -0.06, $p < .05$), and anxiety (B = -0.04, $p < .05$). That study showed that if teachers perceived individual students as having more disruptive behaviour in the past, they were less emotionally reactive to enjoyment when this student was involved in a positive event. In contrast, if they judged the event as negative, teachers reported higher levels of anger and anxiety when they perceived students as more disruptive in the past.

The empirical evidence thus identifies the potential relationships between teachers' emotional experiences and teacher-perceived or student-rated socio-emotional and motivational behaviour. Most studies generally included only three major discrete emotions of teachers (enjoyment, anger, anxiety), and have indicated that perceived students' social-emotional behaviour primarily predicts teachers' negative emotions (i.e., anger, anxiety), especially anger. In contrast, teachers' perceptions of student motivational behaviour mainly predict higher teachers' positive emotions (i.e., enjoyment). However, the results of the relationships between perceived student social-

emotional behaviour and positive emotions and the relationships between perceived student motivational behaviour and negative emotions are relatively mixed. Some studies found that student motivational behaviour protects teachers from anger (de Ruiter et al., 2020; Hagenauer et al., 2015) and anxiety (Hagenauer et al., 2015), but others found perceived student social-emotional behaviour is related to decreasing levels of teacher enjoyment.

Intriguingly, evidence also indicated that the role of student motivational behaviour (= student engagement) in teachers' minds might be even more crucial in evaluating their teaching (Hagenauer & Volet, 2014; Jacob et al., 2017). Successfully fulfilling the goal of student engagement could help teachers feel positive emotions (e.g., joy, happiness, satisfaction, excitement, pride); otherwise, teachers may feel negative emotions (e.g., dissatisfaction, irritation, disappointment, boredom) about their teaching work (Hagenauer & Volet, 2014). Although studies have shown the connections between teachers' perceptions of students' social-emotional and motivational behaviour, the mixed results indicate the need for further research on the relationship between momentary student behaviour and teachers' emotions.

The role of the teacher-student relationship

The teacher-student relationship refers to teachers' and students' perceptions of relations based on their interactions in the classroom. It is "teachers' and students' ongoing perceptions of one another, affect towards each other, and interactions over time; these perceptions are stored in memory and guide future interactions with the other party" (Brinkworth et al., 2018, p. 2). The teacher-student relationship has been seen as a crucial factor for student outcome and school engagement and is correlated to students' emotions (e.g., Bai et al., 2022; Goetz et al., 2021; Martin & Collie, 2019; Roorda et al., 2011). As the importance for students of the teacher-student relationship has been well-established, the importance of the teacher-student relationship for teachers has garnered researchers' attention. Spilt et al. (2011) suggested that the teacher-student relationship plays a significant role in teacher emotions and teacher well-being in the theoretical model. Although the teacher-student relationship could be seen as an aspect of student behaviour perceived by teachers through a wider lens (Frenzel, 2014), compared to students' social-emotional and motivational behaviour, the teacher-student relationship is relatively non-situation-specific but more pervasive in the classroom process.

In the existing literature, the most common approach to understanding the teacher-student relationship is investigating the degree of closeness and conflict

between teachers and students (Ang et al., 2020; Mason et al., 2017). Closeness refers to the warm and positive relationships shared between the teacher and the student, and conflict means the negativity of the relationships (Pianta & Stuhlman, 2004; Spilt & Koomen, 2009).

Previous research has linked teacher-student relationships with teachers' work-related well-being, such as teachers' work engagement, emotional exhaustion, and teaching stress (e.g., Corbin et al., 2019; Gagnon et al., 2019). In a longitudinal study, Corbin et al. (2019) found that the classroom-level teacher-student relationship at the first time point predicts teachers' emotional exhaustion at the second time point. Specifically, teachers who have higher conflictual relationships with their students at the first time point have higher levels of emotional exhaustion ($\beta = 0.32$, $p < .001$). However, a closer relationship with students at the first time point predicts higher teachers' personal accomplishment but not emotional exhaustion. Similarly, Aldrup et al. (2018) utilised the theoretical model by Spilt et al. (2011) to explore the role of the teacher-student relationship between perceived student misbehaviour and teachers' work-related well-being (i.e., emotional exhaustion and work enthusiasm). In their study, the teacher-student relationship mediated the effect of perceived student

misbehaviour on teachers' work enthusiasm (indirect effect β = -0.06, p = .01) but not on emotional exhaustion.

For the association between teacher-student relationships and teachers' emotions, evidence has shown the critical role of teacher-student relationships. For example, in a cross-sectional study in secondary schools, Hagenauer et al. (2015) investigated the associations of teacher emotions with students' engagement, classroom discipline, and teacher-student closeness. They found that the teacher-student relationship is a strong predictor of teachers' joy (β = 0.70, p < .001), anxiety (β = -0.41, p < .001), and anger (β = -0.35, p < .01) when controlling other variables, such as perceived student disruptive behaviour, student engagement, and teachers' self-efficacy.

It is worth noting that in a cross-sectional study, Evans et al. (2019), who followed the model of Spilt et al. (2011), found that the association between teachers' perceptions of student problematic student behaviour and teachers' negative affect was mediated by a teacher-student conflictual relationship (β = 0.32). In addition, the closer the teacher-student relationship is, the weaker the indirect effect of perceived student problematic behaviour on negative affect through the conflictual teacher-student relationship. That is, the closeness between teachers and students could be a protective

factor. This study implies that closeness and conflict may function differently and interact with different paths.

Moreover, research has indicated that the level of teachers' satisfaction with their closeness with their students plays an important role in primary schools. From a perspective of basic psychological need, Klassen et al. (2011) found that teachers who had a higher level of satisfaction about their relationship with students had a higher level of work engagement ($\beta = 0.75$, $p < .01$) and a lower level of emotional exhaustion ($\beta = -0.24$, $p < .01$). However, this is not the case for teachers' satisfaction with their colleagues, in which no significant association was found. In their further study, they found that higher teacher-student closeness was related to higher teacher work engagement ($\beta = 0.47$, $p < .01$), higher teaching enjoyment ($\beta = 0.47$, $p < .01$), and lower teacher anger ($\beta = -0.15$, $p < .01$). These findings suggest that primary school teachers' relationships with students may be more dominant than those with colleagues for their work-related well-being.

Intriguingly, Taxer and colleagues (2019) indicated another possibility of the role of the teacher-student relationship. Instead of using the teacher-student relationship as the mediator, they found that teachers' emotions (enjoyment and anger) mediate the association between the teacher-student relationship and teachers' emotional exhaustion

both cross-sectionally and longitudinally. This echoes Brinkworth et al.'s (2018) concept of the teacher-student relationship: that it involves continuing perceptions regarding interactions in the classroom but also forms a kind of memory that guides the following interactions.

In sum, evidence has supported the theoretical model of Spilt et al. (2011) to address the salience of the teacher-student relationship for teachers, especially its potential effects on teachers' work-related well-being (e.g., emotional exhaustion and work engagement). Most studies investigate the association between teacher-student relationships and teachers' emotions and well-being based on teachers' perceptions of the whole class (group-level) rather than the dyads between teachers and students. Additionally, the associations between teacher-student relationships and other variables (e.g., emotions, student behaviour, well-being) have often been investigated in the same time frame using cross-sectional research. However, the teacher-student relationship, reflecting the interaction of teachers and individual students in the classroom, has individualised and dyadic characteristics that need to be investigated at the dyadic level (Spilt et al., 2011). Because the teacher-student relationship is the accumulative perceptions of interactions, how teachers' mental representations of their relationships

work with particular students needs further research. The role of individual students in the classroom is discussed in the next section (section 2.5.2).

2.5.2 The role of individual students in the classroom

A theme that emerges from previous research and theories regarding teachers' emotional experiences is the role of individual students in the classroom, as teachers' emotions reflect their responses to particular students' behaviour in class (Frenzel, 2014; Spilt et al., 2011). In one classroom, teachers interact with multiple students simultaneously, and each student could have very different behaviour and connections with teachers in the classroom.

Previous research has mostly investigated the relationship between the perceived students' negative behavioural index (e.g., student disruptive behaviour) and teachers' well-being using negative indicators (e.g., burnout, emotional exhaustion, and stress), which indicated the potential role of individual students in the classroom. In a sequence of studies about individual students and teachers in school settings, de Ruiter et al. (2019) indicated that students' social-emotional (i.e., perceived student disruptive behaviour such as aggression and hostility) and relational behaviour, compared to students' achievement or motivational behaviour (e.g., student engagement) are more important for primary school teachers' emotions such as enjoyment, anger, anxiety, and

other-related emotions. In both a cross-sectional and a daily diary study, de Ruiter et al. (2020) found that teachers have more negative emotional reactions to students they perceive as being disruptive in the past when facing negative events.

Prior studies have suggested that teachers' perceptions of particular students' behaviour in the classroom are precursors for teachers' self-efficacy. For instance, Zee et al. (2016) found that teachers' self-efficacy toward a particular student is linked to the student's social-emotional behaviour, especially an individual student's externalising behaviour (e.g., hyperactive or temper tantrums) and prosocial behaviour (e.g., help others). However, the classroom-level student behaviour (i.e., teachers' perceptions of the overall classroom) moderates the relationship between an individual student's externalising behaviour and the teacher's student-specific self-efficacy (B = -0.19, p < .01). Thus, teachers' belief in their capability to manage individual students' externalising behaviour decreases when they perceive more classroom-level misbehaviour.

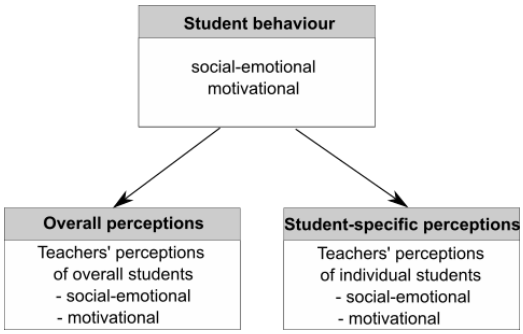
Intriguingly, the way teachers interact with individual students may go beyond general assumptions. Denessen et al. (2020) observed eight primary school classes (9-10 years old students) to investigate the teacher-student interaction in the classroom. In these classrooms, teachers do interact with individual students differently. In contrast to

the researchers' expectation, teachers tend to interact more frequently with their low-performing and low-expectation students rather than the high-expectation or high academic achieving students. In addition, teachers were more involved with these students in the classroom; for example, teachers would ask questions directly to a student and provide relatively more feedback. Similarly, in a micro-longitudinal study in primary schools, Malmberg and Martin (2019) found that teachers were more involved with lower-performing (ρ = -0.45; $p < .001$), less competent (ρ = -0.28; $p < .001$) and less task-focused (ρ = -0.42; $p < .001$) students, implying that teachers spent more time and exerted more effort with these students. Thus, how teachers are involved with particular students in the classroom is still an open question waiting to be investigated.

In a similar vein, de Ruiter et al. (2021) found that teachers' relationships with students may play an even more important role when investigating the effect of teachers' daily event appraisal of selected individual students (perceived as more disruptive in the past) on their emotional expression (e.g., genuine expression or surface acting). They found that teachers express more genuine emotions when in closer relationships but express less genuine emotions when in conflictual relationships, considering teachers' perceptions of students' past disruptive behaviour.

Overall, these findings suggest the complexity of teacher-student dyads in the real-time classroom. Although previous research has long mentioned the role of individual students with teachers (e.g., Hargreaves, 2000), research that explicitly focuses on this issue (e.g., de Ruiter et al., 2019, 2020, 2021) considering teachers' emotional experience in the momentary classroom is relatively scarce. The emphasis on the interplay between individual students and teachers in the classroom does not mean teachers' perceptions of overall students are not meaningful. Instead, two levels of teachers' perceptions of students may form during the teaching process (see Figure 3). Teachers' general perceptions of the classroom and their student-specific perceptions could interact with each other (e.g., Zee et al., 2016). Further, understanding the relationship between teachers and individual students in the classroom can be beneficial in decomposing the mechanism of teacher-student interplay and locating the entry point to support teachers and students.

Figure 3 Two levels of teachers' perceptions of students' behaviour



2.5.3 Teacher well-being as the potential outcome of emotional experiences

The concept of teacher well-being is multifaceted, with multiple layers (Diener et al., 2017), including elements such as teachers' happiness and fulfilment with their professions (Acton & Glasgow, 2015). The broaden-and-build theory suggests that the accumulation of individuals' positive emotional experiences could support the increase of individuals' well-being (Cohn et al., 2009; Fredrickson & Joiner, 2002). In this research, teacher well-being is a concept that contains teachers' subjective evaluation of both their work-related life and their general life (Diener, 2000; Diener et al., 2017). As work-related well-being is more specific and related to the experiences during working hours, teachers may reflect on it daily (Simbula, 2010). However, teachers' general well-being does not directly link to any specific domain of life; it rather concerns a broader, general, and overall judgement.

Research has implied the importance of including both positive indicators (e.g., work engagement, enthusiasm) and negative indicators (e.g., emotional exhaustion, disengagement) to assess teachers' work-related well-being (e.g., Aloe et al., 2014; Collie & Martin, 2017; Taxer et al., 2019). Chang (2013) indicated that teachers' momentary negative emotion is predicted by perceived student disruptive behaviour (e.g., appraisal of student behaviour is incongruent with goals: $\beta = 0.26$, $p < .05$), and

further leads to burnout ($\beta = 0.44$, $p < .05$). That is, having higher momentary negative emotions is related to the possibility of burnout in the teaching job.

Similarly, de Ruiter et al. (2020) found that teacher-perceived past student disruptive behaviour directly predicts teachers' anger level ($\beta = 0.11$, $p < .05$). In addition, higher teacher anger predicts lower teacher daily occupational (work-related) well-being, such as teachers' dedication (reflects work engagement, $\beta = -0.28$, $p < .001$) and emotional exhaustion ($\beta = 0.24$, $p < .001$). If teachers feel higher levels of anger, they tend to have lower engagement levels.

As for the link between emotional experiences and general well-being, Manasia et al. (2020) investigated 1,092 pre-university teachers in a cross-sectional study. Teachers' teaching emotions, especially enjoyment, have been substantially associated with teachers' general well-being ($\beta = 0.41$). Research has also found evidence of the link between emotions and individuals' well-being and life satisfaction in children. For example, Veronese and colleagues (2012) investigated 74 schoolchildren (mean age 10.8 years old) in a severe context (i.e., war). They found that children's positive emotional experiences (e.g., positive emotions and pleasantness on the scale) predicted higher levels of life satisfaction and happiness, and negative emotions (i.e., fear) predicted children's lower levels of life satisfaction. The findings indicate that positive

emotions could contribute to well-being in children and work as a buffer in a severe context.

Overall, it is plausible that a link exists between teachers' emotional experience and well-being regarding both their work life and their life as a whole. However, the term well-being has been used interchangeably for work-related well-being and general well-being. Most research on teacher emotional experiences and well-being was carried out in cross-sectional studies to understand the relationship. Based on the different degrees of specificity and timeframe, it is likely that teachers' emotional experiences, work-related well-being, and general well-being are cyclical. The mechanism and relationships between teachers' momentary emotional experiences and their work-related well-being and general well-being still need further study.

2.5.4 Emotional contagion between teachers and students

Research has been conducted to explore the transmission phenomenon in an educational context from different perspectives, such as satisfaction (Houser & Waldbuesser, 2017) and flow (Bakker, 2005) in a broader sense. Additionally, evidence supports that emotional contagion exists in different cultures (Hansen & Mendzheritskaya, 2017). This section reviews key research that focuses on the transmission of emotions in the classroom.

Previous cross-sectional research has indicated that the emotional contagion phenomenon exists between teachers and students in the classroom at different education stages. Investigating the relationship of emotional responses between university instructors and 465 students, Mottet and Beebe (2000) found that students' perceptions of instructors' pleasure, arousal, and dominance are significantly correlated with students' pleasure ($r = 0.6$, $p < .001$), arousal ($r = 0.32$, $p < .001$), and dominance ($r = 0.12$, $p < .01$). Chang and Cherng (2017) implemented a cross-sectional study in Taiwanese secondary schools to explore the emotional contagion between teachers' (student-reported teacher emotions) and students' positive emotions (enjoyment, hope, and pride) and negative emotions (anger, anxiety, shame, hopelessness, and boredom). Results indicated that student-perceived teachers' positive emotions predicted students' positive emotions ($\beta = 0.70$, $p < .05$), and student-perceived teachers' negative emotions predicted students' negative emotions ($\beta = 0.68$, $p < .05$).

Becker et al. (2014) conducted a study using the experience sampling method to investigate the contagion of enjoyment, anger, and anxiety between teachers and students in secondary schools (mean age 15.63 years old). Students' perceptions of their teachers' emotions predicted their own emotions (enjoyment: $\beta = 0.27$, $p < .001$, anger: $\beta = 0.22$, $p < .001$, anxiety: $\beta = 0.12$, $p < .05$). Similarly, Keller and Becker (2021)

investigated emotional contagion in the classroom in secondary schools and found that student-perceived teachers' enjoyment ($\beta = 0.27$, $p < .001$), anger ($\beta = 0.20$, $p < .001$), and anxiety ($\beta = 0.16$, $p<.001$) were predictors of student emotions, considering teachers' authenticity. Overall, students' self-reported emotions matched their perceptions of teachers' emotions to some extent.

Although research has provided evidence that teachers' emotions could transmit to students, most of these studies were single-informant studies based on students' ratings of their own emotions and teachers' emotions rather than multiple-reporter studies investigating the relationship between teacher-reported emotions and student-reported emotions. Two longitudinal studies concerning the emotional contagion of enjoyment have provided insights into this question. Collecting both teacher and student reports, Frenzel et al. (2009) examined the relationship between teacher-reported enjoyment and student-reported enjoyment in Grades 7 and 8. Findings indicated that students' enjoyment in Grade 7 predicted their enjoyment in Grade 8 ($\beta = 0.53$, $p < .01$), and student-reported enjoyment in Grade 7 was related to teacher-reported enjoyment in Grade 8. The relationship between teachers' enjoyment in Grade 8 and student enjoyment in Grade 8 was mediated by students' perceptions of teachers' teaching enthusiasm. Expanding this research, Frenzel et al. (2018) further discussed the

relationship between teacher-reported enjoyment and student-reported enjoyment at three time points. Similarly, students' enjoyment between the first time point (beginning of school year) and the third time point (midterm) was stable (within class: $\beta = 0.41$, $p < .01$; between class: $\beta = 0.41$, $p < .01$). Student enjoyment at the beginning of the term (T1) did not directly predict teacher-reported enjoyment (T3) but did predict teacher enjoyment via teacher-perceived student engagement at the second time point (a month into the school year). Interestingly, when considering the other variables, teachers' enjoyment at the first time point (T1) negatively predicted students' enjoyment at the third time point (T3). However, higher student-perceived teacher enthusiasm at the second time point was predicted by teachers' enjoyment at T1. Also, student enjoyment at the third time point was predicted by student-perceived teacher enthusiasm at the second time point. This suggests that the relationship between teacher-reported emotions and average student-reported emotions (at the between-class level) may relate to each other through the display of observable behaviour, primarily through their perceptions.

Overall, the mechanism of teacher-reported emotions, student-perceived teacher emotions, and student-reported emotions is less clear. In addition, most previous research has focused on the direction from teachers to students (student-perceived

teacher emotions predict student emotions), but not the other way around. More specifically, the reciprocal relationship between teacher momentary emotions and student momentary emotions needs further investigation.

2.6 SUMMARY: THE PERSPECTIVES ADOPTED

This chapter provides a brief review on the topic of teachers' emotional experiences. Key theories and previous hypothetical models informed this research, and existing empirical literature on teacher emotional experiences was reviewed and discussed. The literature indicates that despite increasing interest in teachers' emotional experiences in the classroom, a large body of research has focused on the cross-sectional relationship in teachers' emotional experiences (J. Chen & Cheng, 2022). Although existing literature studying teachers' momentary emotional experiences in the classroom provides insights into the field, most research focuses on settings in secondary schools. The mechanism underlying the relationship between momentary students' behaviour and teachers' emotional experiences considering teacher well-being, especially in primary schools, still needs further investigation.

As teachers invest considerable time and effort in the classroom, teachers' emotional experiences have been identified as connections to their evaluations of the classroom, students, teaching, and teacher-student interaction shaping (Meyer & Turner,

2007; Zembylas, 2004). Expanding the knowledge of the reciprocal relationship between teachers' and students' momentary emotions in the classroom is needed. The vast majority of studies of the contagion between teachers' and students' emotional experiences focus on unidirectional (teachers to students) and from students' perspectives (e.g., students' perceptions of both teachers and themselves). Few studies have investigated potential reciprocal relationships, especially momentary ones.

The literature, particularly through the contribution of teacher interviews, also indicates the different interactions and relationship qualities between teachers and individual students. However, to the best of my knowledge, research into teacher-student dyads on teachers' emotions in the classroom remains scarce. Mainly, sparse studies have focused on the positive effect of individual students' behaviour (e.g., engagement) on teachers.

To summarise, this research was positioned in real-time classrooms in primary schools to investigate teachers' momentary emotional experiences and the interplay between teachers and students. The next chapter will introduce a proposed conceptual model drawing on the existing literature and the overall research questions.

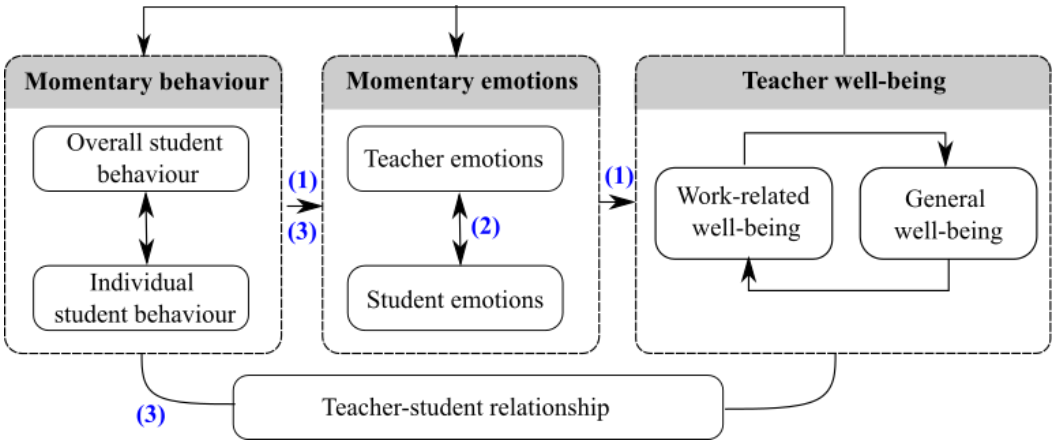
CHAPTER 3. RESEARCH AIMS AND QUESTIONS

This chapter aims to provide an overview of the overarching conceptual framework and research aims and questions of this thesis. First, the overarching conceptual framework of the thesis based on theories and the literature review is outlined, and the key concepts within it and their relationships are introduced and explained. The next section describes the main aims and the overarching research questions that guide the three studies in this thesis.

3.1 CONCEPTUAL FRAMEWORKS

Based on a review of previous research in Chapter 2, a teacher-student emotional experience model was proposed (See Figure 4). This overall conceptual framework guided the studies presented in this thesis; each study addressed parts of the overall framework.

Figure 4 *Proposed research framework*



Note: (1): the focus of Study 1. (2): the focus of Study 2. (3): the focus of Study 3.

As shown in Figure 4, first, teachers' momentary emotions (in the mid-section of Figure 4) link with the antecedents in the classroom, specifically their perceptions of students' behaviour such as their motivational (e.g., student engagement) and social-emotional behaviour (e.g., perceived student disruptive behaviour). As indicated in the mid-section of Figure 4, teachers' momentary emotions connect to students' momentary emotions (shown as double-headed arrows). Further, teachers' momentary emotions could shape teachers' work-related and general well-being. Finally, teachers' relationships with individual students are seen as an important context in this cyclical process (shown as a line without any arrows), which interacts with other paths in the model and reflects teachers' perceptions of individual students in the classroom.

Drawing on the broaden-and-build theory and appraisal theory (e.g., Fredrickson, 2004; Garland et al., 2010), the conceptual model postulates that teachers' positive and negative emotional experiences could be triggered by in-class antecedents, namely students' behaviour, mainly based on teachers' perceptions of these antecedents. Furthermore, the accumulation of positive emotions could lead to increased flexibility in dealing with challenges during work and enhance general well-being. Negative emotional experiences, on the other hand, could trigger narrowed self-focus and reflect on teachers' evaluation of work-related well-being. The model, grounded in previous

hypothetical models and research (Frenzel, 2014; Spilt et al., 2011), specifies the student antecedents and addresses the cyclical process of teachers' emotional experiences stemming from their interactions with students in the real-time classroom, which influence their general well-being over time. The proposed model expands prior models in that it depicts a dynamic and reciprocal process of teachers' and students' emotional experiences in the classroom, where, is consistent with the theory of emotional contagion (Hatfield et al., 1994; Westman et al., 2013), teachers' and students' positive emotions could be transmitted to others. A further advantage of the model is that it addresses the role of individual students (the left part of Figure 4). Additionally, the model incorporates teachers' work-related and general well-being and their relationship with teachers' emotional experiences, concerning different time layers. Last, the model presents teachers' perspective of their emotional experiences with students, which could connect to students' perspective of their emotional experiences with teachers (e.g., the connection between teachers' behaviour, student emotions, and student well-being). Although the current model does not include every part of students' perspective, it has the potential to expand and include the interaction between teachers' and students' perspectives into a larger scope based on the existing literature (e.g., Frenzel, 2014).

In this thesis, three studies focused on the different parts of this overall framework from teachers' perspectives. Study 1 addresses the cyclical process of teachers' emotional experiences from their momentary emotions to their general well-being, and teachers' perceptions of students as a whole. Study 2 focuses on the momentary emotional experience, which addresses the relationships between teachers' and students' emotional experiences. Study 3 focuses on the dyadic relationship between teachers and individual students in the context of the teacher-student relationship.

To summarise, this overall research framework examines teachers' emotional experiences and teachers' well-being over time, addressing the important role of teachers' momentary emotional experiences and their classroom antecedents. Additionally, the relationships between teachers and students are examined. Although the studies presented in this thesis do not cover all the possible links in Figure 4, taken together, they answer the research questions that are posed.

3.2 AIMS AND RESEARCH QUESTIONS

The overarching aim of this thesis is to investigate the dynamic of teacher emotional experiences and the interplay between teachers' and students' emotional experiences in class. More specifically, the aims of this thesis are to investigate: (1) teachers'

momentary emotional experiences, their perceptions of student antecedents, and their day-to-day work-related well-being and their general well-being, (2) emotional contagion and the directionality of emotional contagion between primary school teachers and students across lessons, and (3) the association between teachers' perceptions of individual students' engagement and teachers' emotions in teacher-student dyads. The overarching research questions addressed in this thesis to guide the three studies are:

(1) What are the relationships between teachers' situation-specific emotions, their day-to-day work-related well-being, and their general well-being? (Study 1)

(2) What are the relationships between teachers' situation-specific emotions and their perceptions of student behaviour? (Study 1)

(3) What are the relationships between students' emotions, students' perceptions of their teacher's emotions, and the teachers' self-perceived emotions? (Study 2)

(4) How does individual students' engagement relate to teachers' emotions? And does teacher involvement moderate the relationship between student engagement and teachers' momentary emotions? (Study 3)

The four overarching research questions further break down into specific sub-research questions in each study (see Chapter 5 to Chapter 7).

CHAPTER 4. METHODOLOGY

4.1 CHAPTER INTRODUCTION

Based on the overarching aims and research questions guiding the studies that were presented in Chapter 3, this chapter outlines the overall research design and methodology of the thesis. Section 4.2 presents the overall design (i.e., a micro-longitudinal design) applied in this research. Section 4.3 provides an overview of the pilot studies conducted prior to the main research. Section 4.4 presents the sampling and recruitment of the participants, followed by the illustration of the characteristics of the participants. The research procedure is presented in section 4.6, followed by a discussion of ethical considerations. Sections 4.8 and 4.9 present an overview of the measures used in the three studies and their reliability and validity. The chapter concludes with a summary and an outline of the data analysis.

4.2 QUANTITATIVE MICRO-LONGITUDINAL DESIGN

Given that the aim of this thesis is to capture real-time dynamics regarding emotional experiences in the classroom, the overall approach employed is a quantitative-based micro-longitudinal design.

Micro-longitudinal designs (also known as *intraindividual, within-person, or idiographic designs*) address an individual's performance in different situations and can

be dated back to the distinction and definition of *nomothetic* and *ideographic* research by Wilhelm Windelband in 1894 (Hamaker, 2012; Lamiell, 1998). To date, idiographic in psychology could refer to the designs that aim to recognise patterns of behaviour within a person across various situations, namely the intra-individual process. In contrast, nomothetic could refer to designs that aim to recognise patterns of behaviour across individuals; in other words, the between-person differences, which usually are cross-sectional or large-sample approaches (Conner et al., 2009; Hamaker, 2012).

The micro-longitudinal design assesses situations repeatedly on a micro timescale, such as sampling experiences at moments or days (Bamberger, 2016). In this thesis, the term micro-longitudinal method or micro-longitudinal study is used to refer to the design assessing participants repeatedly in relatively short time intervals. A micro-longitudinal method allows the researcher to capture little experiences of thoughts, feelings, and behaviour in daily life and characterise each subject's change process through a sequence of repeated measurements (Bolger et al., 2013).

The application of micro-longitudinal designs has several advantages. The main benefits are to (1) minimise retrospective bias, (2) increase ecological validity, and (3) specify temporal events and the within-person changes in a process (Bamberger, 2016). This is ideal for the present research, where the aim is to collect data in participants'

natural context and capture the dynamic process of individuals' changing psychological phenomena such as emotions. By adopting an intraindividual approach, the research aims to expand the understanding of everyday teachers' and students' emotional experiences in primary schools in Taiwan.

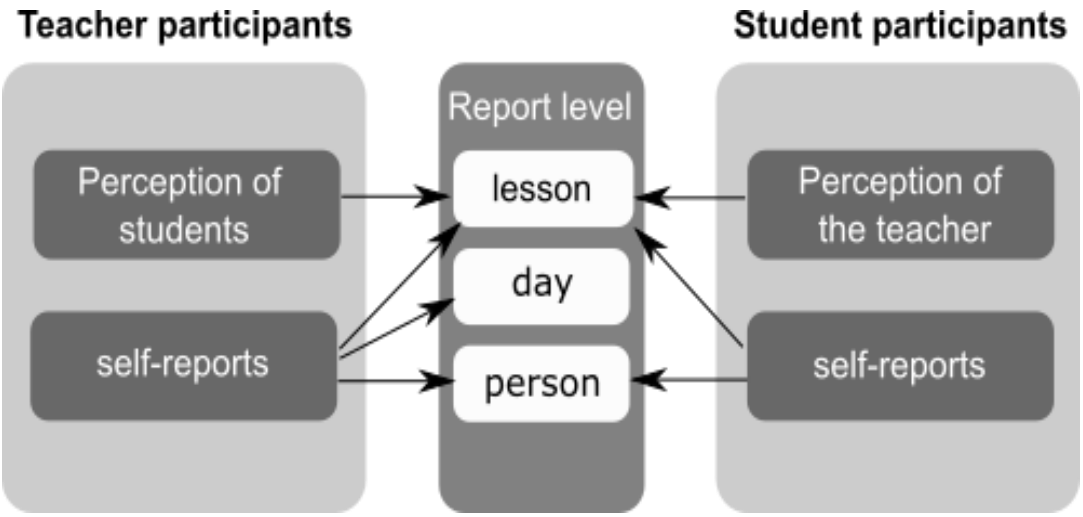
Some well-being research has indicated that momentary emotional experience is a part of the well-being process that reflects a person's situational well-being (Dimotakis et al., 2011; Tay et al., 2014), and an increasing number of studies have delved into teachers' emotional experiences in real-time situations (e.g., Becker et al., 2014; Carson et al., 2010; Keller & Becker, 2021). A limitation of previous research is using a cross-sectional design to infer the interaction between teachers' and students' emotions and discussing well-being issues without considering the context of real-time interactions in school settings. As individuals' sense of well-being encompasses (and amounts to an overall judgement about) their working and professional lives, traditional cross-sectional designs cannot take the fluctuations of teachers' momentary emotional experience and situational factors from interaction with students into account. An intraindividual approach is desirable because it can provide a more comprehensive picture of the process of teaching and learning (B. Schmitz, 2006).

Previous studies have shown that it is feasible to use ecological momentary assessment and day reconstruction to understand some specific discrete emotions of students and teachers (Becker et al., 2015; Frenzel et al., 2015). These studies shed light on how repeated measurements can be used to capture teachers' momentary emotional experiences, which minimises retrospective bias. For example, by asking teachers to report their enjoyment, anger, and anxiety after teaching each lesson (German, mathematics, and science) over two weeks, Frenzel et al. (2015) found that teachers' emotions varied from one lesson to another, similar to the findings of Becker et al. (2015). This implies fluctuation of teachers' emotional experiences in various situations.

To understand the emotional experiences of teachers and students in Taiwanese primary schools, this research used an ecological momentary assessment protocol (Bamberger, 2016; Shiffman et al., 2008). In particular, to understand teachers' and students' experiences in lessons, it adopted a micro time scale in a calendar week. To minimise disruption, a pre-specified timescale based on lessons was used. Participants were asked to complete a questionnaire at the end of each lesson (taught by homeroom teachers) for one week's time.

Then, this research incorporated assessments of multiple reporters' self-reported data across multiple lessons. As shown in Figure 5, this research used a parallel data collection structure for teacher and student reporters. Thus, apart from teachers' and students' self-reports of their daily or personal level data, both teacher and student participants reported their own emotions, and student participants also reported their perception of their teachers' emotions at the end of lessons. Moreover, to shed light on dyadic interactions between teachers and individual students in class, teachers rated individual students' (i.e., target students) engagement at the end of each lesson.

Figure 5 *Research design*



4.3 PILOTING OF DATA COLLECTION ACTIVITIES

The main aim of this research is to understand teachers' and students' emotional experiences from a micro perspective, measured by teachers' and students' momentary emotions as well as their life satisfaction. Based on the review of the literature, few studies have focused on teachers' and students' academic emotions in school settings in Taiwan (e.g., Chang & Cherng, 2017). An exception is Chang and Cherng (2017), who explored secondary school teachers' positive and negative academic emotions (based on eight discrete emotions, i.e., enjoyment, hope, pride, anger, shame, hopelessness, and boredom) through student reports, using a cross-sectional approach. Research on academic emotions in Taiwan is at an early stage and mainly uses interview-based methods or cross-sectional research methods. To date, to the best of my knowledge, no study has investigated the momentary emotional experiences of teachers/students in Taiwan. Therefore, the pilot study focused on understanding teacher and student emotional experiences and interactions in school settings in Taiwan.

In order to explore the potential emotional experiences of primary school teachers and students, as well as the feasibility and challenges of the research design, two pilot studies were conducted prior to the main study: A semi-structured interview and a pilot for checking procedures. The detailed results of the pilot studies have not

been included in this thesis, as the main aim of the two pilots was to guide the development and forming of the main instruments (e.g., the wording of items, face validity and age appropriateness of emotional expressions in Taiwanese context) and to test the procedure of the main study (For details regarding the procedure and participants please see Appendix A). Below is a brief overview and reflection regarding the two pilot studies.

Pilot Study 1

Pilot study 1 involved semi-structured interviews of teachers and students to enhance understanding of emotional experiences during lessons from teachers' and students' perspectives. Three public primary school teachers and three Year 3-4 students were recruited. Based on previous research, Year 3-4 students should be able to understand the mixed nature of emotions in the classroom (Pons et al., 2004). During the interview period, an emotion checklist was also provided to participants using electronic devices (tablets) to pilot the feasibility of using devices to complete questionnaires using application software. Different words for emotions were included to select the suitable words to use in the main study.

The results indicated that primary school teachers experience various common and important emotions (e.g., anxiety, anger, enjoyment, disappointment, pride) when

teaching and interacting with students. Student behaviour and emotions could affect teachers' emotions positively or negatively, which could lead to reward or disappointment. For example, if students' engagement level is low or students misbehave in the classroom, teachers experience negative emotions such as anger. On the other hand, teachers experience a sense of happiness or achievement when students engage in the lesson or participate in the discussion. Interviews with students, on the other hand, indicated their most frequent emotions (e.g., anger, enjoyment, anxiety, relaxation) and emotions they are not familiar with (e.g., hope). As previous research has mainly focused on three emotions for secondary school students: enjoyment, anger, and anxiety (Becker et al., 2014; Frenzel et al., 2018; Frenzel, Goetz, Lüdtke, et al., 2009), the understanding of the range of emotions experienced by Taiwanese primary school students is limited. The first pilot study provided evidence and extended details about the important aspects of teachers' emotional experiences and students' perceptions in the school settings, teacher well-being, and teachers' and students' emotional interplay in the classroom. The results also indicated that both teachers and students gave positive feedback regarding the usability of the questionnaire application and the feasibility of using the devices.

Pilot Study 2

Based on the first pilot study's results, the wording and the emotions selected were adjusted and a questionnaire incorporating the changes was developed. The aim of the second pilot was to test the procedure during the lesson in the primary school. A Taiwanese homeroom teacher and her students were recruited and completed a paper-and-pencil questionnaire during one lesson. Students' self-reported emotions, their perceptions of teachers' emotions, student engagement, and teachers' support were assessed. The pilot provided valuable opportunities to understand teachers' and students' dyadic interactions and emotional experiences in school settings, as well as the feasibility of the data collection procedure. Results indicated that a procedure involving lesson-specific design is feasible, and students perceived teachers' emotions to have a positive association with students' emotions. The second pilot study provided meaningful information regarding whether Year 3-4 students were old enough to properly understand their own and teachers' emotions and the wording and layout of the questionnaires.

The design of the present study has been informed by both pilot studies (for more details, please see Appendix A). Based on the feedback from teachers and students in the pilot studies, it was decided that the situation-specific teaching and learning

experiences (and daily questionnaires for teachers) would be administered via electronic devices in Year 4 and Year 5 classrooms. The findings of the pilot studies indicated that an intraindividual investigation of teacher and student emotional experiences was desirable, as a link between teachers' and students' behaviour and emotional experiences was emerging.

4.4 SAMPLING AND RECRUITMENT

The target population of this research was public primary school homeroom teachers and students in Year 4-5 classes in Taiwan. The study employed purposive and convenience sampling to ensure that schools and participants that volunteered matched the target population and the samples included a variety of schools in the goal areas. Since the research aimed to include both teachers and students as participants, Year 4-5 teachers and students were selected based on whether students can easily understand the items and the school plan for the whole academic year.

The design of the study was hierarchical (lessons nested within day reports within teachers) and involved both teachers' perspectives and students' perspectives (lessons nested within students). As there is a nested relationship between teachers and students, a sample at the higher level was drawn (e.g., teachers and then students),

followed by a sample of the sub-units (e.g., measurement days/ measurement lessons) at the lower level.

Schools were recruited through contact with head teachers. After providing information sheets and receiving the verbal consent of the head teachers, the researcher met with the head teachers to explain the details of the research and field questions. Upon gaining signed consent to conduct the study in the school from the head teachers, the researcher sent a recruitment leaflet to Year 4 and Year 5 teachers. After gaining the verbal consent of teachers, the researcher met with them to introduce and discuss the project. Information sheets and written consent forms were distributed to students' parents if the homeroom teachers provided written consent to participate. Students were also asked for assent after the researcher gave them an introduction to the project and fielded questions to ensure students' willingness. Opt-in consent from parents was used to ensure parents were fully informed and could raise queries about the research. All information sheets and consent forms in Mandarin and English are included in Appendix B and Appendix C.

In total, teachers and students in eight public primary schools in Taiwan took part in this study. The schools are diverse in size (from 12 classes per school to 110 classes per school, approximately two classes to 18 classes per year group) and school

districts in the Taipei metro area, with four in New Taipei City and four in Taipei City. However, the class size in different schools is comparable (20-28 students). As shown in Table 1, the participation rate of students in each class and school varied, ranging from 24 % to 100% across classes and 24% to 95% across schools.

All eight primary schools were public schools, one school (School 8) was a small-scale primary school (the total number of classes ≤ 12), and three schools (School 2, 4, 5) were large-scale primary schools (the total number of classes ≥ 61). This reflects the school size in Taipei City and New Taipei City. Large-scale schools are relatively common in New Taipei City, while general-size schools are common in Taipei City. Homeroom teachers in New Taipei City schools (Schools 1, 2, 4, 5) have 16 lessons per week, while teachers in Taipei City schools (Schools 3, 6, 7,8) have 15 lessons per week.

Table 1 *Participation rate in schools and classes*

School	Class	Students (total)	Participation rate (class)	Students recruited (per school)	Participated (school)	Participation rate (school)
1	1	22 (28)	0.79	28	22	0.79
2	2	17 (27)	0.63	80	60	0.75
	3	21 (27)	0.78			
	4	22 (26)	0.85			
3	1	12 (28)	0.43	28	12	0.43
4	1	6 (25)	0.24	25	6	0.24
5	1	19(23)	0.83	119	75	0.63
	2	11(24)	0.46			
	3	13(24)	0.54			

School	Class	Students (total)	Participation rate (class)	Students recruited (per school)	Participated (school)	Participation rate (school)
	4	20(23)	0.87			
	5	12(25)	0.48			
6	1	15(24)	0.63	123	71	0.58
	2	8(24)	0.33			
	3	20(24)	0.83			
	4	17(25)	0.68			
	5	11(26)	0.42			
7	1	11(21)	0.52	41	23	0.56
	2	12(20)	0.60			
8	1	21(21)	1.00	41	39	0.95
	2	18(20)	0.90			
Total		308(485)		485	308	0.635

4.5 PARTICIPANTS

In total, 20 primary school homeroom teachers and 308 students in Year 4 or Year 5 classrooms across eight public primary schools participated in the research. Four target students in each class were selected based on teachers' nomination, and thus 80 out of 308 students were selected as target students for the purpose of examining the interaction of teacher-student dyads. In Study 1, teacher data were used to investigate the cycle of teachers' momentary emotions, teacher-perceived student behaviour, and teachers' well-being. In Study 2, data from teachers and overall students were used to answer the research question regarding the reciprocal relationship between teacher emotions and student emotions. In Study 3, paired teacher data and target student data were employed to examine the teacher-student dyadic relationship.

4.5.1 Teacher participants

Overall, there were 20 teachers (Male = 2, Female = 18) aged from 28 to 55 years old (M_{age} = 43.05 years, *SD* = 9.01 years) participated in this research. 45% of teachers taught Year 4 and 55% taught Year 5. Their teaching experience ranged from 2 years to 30 years (*M* = 16.13 years; *SD* = 8.56 years). In total, half of the teachers had bachelor's degrees and the other half of them had master's degrees (see Table 2).

Table 2 *Demographic of teacher participants*

Variable		N	Percent (%)	M	SD
Gender	Male	2	10		
	Female	18	90		
Age		20		43.05	9.01
Teaching experiences		20		16.13	8.56
Grade	Year 4	9	45		
	Year 5	11	55		
Education levels	Bachelor	10	50		
	Master	10	50		

4.5.2 Student participants

As Table 3 shows, 308 students participated in this research (Boy = 164, Girl = 144). All students were between 9-12 years old, and the mean age of students was 10.39 years (*SD* = 0.66 years). 42.9% of the students were in Year 4 and 57.1% of student participants were in Year 5. In this research, the family socioeconomic status (SES)[2] of

[2] The family socioeconomic status of students in this research was assessed based on the household level. According to previous studies and criteria in Taiwan (Hwang, 2008), family educational level and

students was relatively homogeneous, with less than 4.6% of student participants have low family SES. This reflects the characteristics of the areas (Taipei and New Taipei City) this study sampled. Overall, 38.6% of the participants had low to medium level family SES, and 61.4% of the participants had medium to high family SES.

4.5.3 Selection of target students

To investigate teacher-student dyads in Study 3, target students were selected from the overall student participants. Before the research period, teacher participants were asked to nominate 4-6 students to whom they gave more attention in the previous class, and another 4-6 students they gave less attention to in the previous class. This reflects the extent to which teachers were involved with individual students in the previous lessons. A total of four students were selected in each class to participate in the research, with two in each group based on the level of involvement teachers reported. In total, 80 students were selected as target students (Boy = 46, Girl = 34). Out of the target students, 45% of them were Year 4 students and 55% of them were Year 5 students (see Table 3).

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occupational level (the higher one in the family) were categorised to calculate the overall family SES based on the formula of Hollingshead (1971) and sorted into five levels.

Table 3 *Demographic of student participants*

Variable		N	Percent (%)	M	SD
Student (N=308)					
Gender	Boy	164	53.2		
	Girl	144	46.8		
Age		306		10.39	0.66
Grade	Year 4	132	42.9		
	Year 5	176	57.1		
Family SES	Low	0	0		
	Medium Low	14	4.6		
	Medium	103	34.0		
	Medium High	80	26.4		
	High	106	35.0		
Target student(N=80)					
Gender	Boy	46	57.5		
	Girl	34	42.5		
Grade	Year 4	36	45		
	Year 5	44	55		

Note: Family SES = Family socioeconomic status

4.6 PROCEDURES

In total, 20 teachers in eight public primary schools consented to participate, and their 485 students were invited (308 students participated, participation rate 63.5%[3]). Parents who consented helped their children to provide demographic information (e.g., date of birth, family socioeconomic status). Before the research started, an orientation session was attended by each teacher, during which teachers were instructed on how to fill in

[3] The observed student participation rate could reflect the impact of the opt-in consent strategy used in this study that required parents to respond actively. In addition, the given participation rate might also be attributed to the relatively long-term research design, which is uncommon in the context of educational research in Taiwan. Based on the observation of the researcher, how homeroom teachers communicated and interacted with parents may affect the student recruitment process. These provided feedback for the recruitment process in Taiwanese primary schools using a micro-longitudinal design.

the electronic day and lesson questionnaires during the data collection period. Likewise, the researcher also provided an orientation session to students explaining the purpose of the research, demonstrating the whole process, and showing them how to fill in the paper-and-pencil questionnaire and use devices to complete the electronic questionnaires. The aim of the orientation sessions for teachers and students was to ensure that all participants were well-informed about the research aim and understood the research process. The researcher answered any questions teachers and students raised and assisted with issues regarding using electronic devices. This was to assist teachers and students with the initiation of the research.

Before and at the end of the main research period, all participants completed a paper-and-pencil questionnaire containing questions about demographic information and individual-level information (e.g., teachers' general well-being). The main research period lasted for a calendar week. During this period, participants responded to the questions via electronic devices at the end of each lesson taught by homeroom teachers (overall, approximately 45% - 55% of lessons in a classroom were taught by homeroom teachers). Teachers' median response time was 146 s, and students' median response

time was 82 s[4]. Teacher participants, in addition, completed a short electronic questionnaire in the morning and at the end of work every day, and a questionnaire of their relationships with students. The researcher visited the teachers at least twice to monitor the data collection during the primary research period. Teachers were encouraged to communicate with the researcher at any time if there were any difficulties or issues.

4.7 ETHICAL CONSIDERATIONS

Ethical approval was granted by the Central University Research Ethics Committee (CUREC) at the University of Oxford. As this research includes both teacher and student participants in primary school settings, CUREC protocols 15 and 25 are applicable.[5] This research also followed the code of ethics for the education field in Taiwan.[6]

Participants' willingness to participate in the research was considered when conducting this study. Therefore, an opt-in strategy was adopted (see Appendix C for

[4] In general, it took teachers less than 3 minutes and students less than 2 minutes to complete all the questions in the questionnaire, close to the expected 3 to 5 minutes window.

[5] Protocol 15 is applicable for teachers and teaching in educational settings, and protocol 25 is applicable for children (under 16 years old) using non-invasive methods.

[6] It specifies guidelines for conducting educational research during the whole process, such as informed consent, beneficence, respect for people's rights and dignity, data protection, privacy and confidentiality.

the consent form). First, permission was sought from the head teachers at primary schools. Then, teachers were recruited through information sheets. If teachers consented to participate in the research, students were informed about the study visit by the researcher. Parent information was provided via a leaflet with details and the procedure for making a complaint. Parents were required to submit a signed consent form. Only those students with parental consent and their own assent (based on protocol 25, see Appendix C for the assent form) were included in the study. To ascertain children's willingness to participate in the research, they were asked to give their assent independently after the research and the procedure for withdrawing from the research was explained. In addition, whenever participants completed the questionnaire, they logged on to the devices using a personal login to ensure they were willing to complete the questionnaire at that time.

The potential impact of the study on participants' teaching and learning and non-participating students was considered. As this study only asked participants to fill in the questionnaires during the last 5 minutes of each lesson, it was considered that the impact on each lesson would be minimal. However, to minimise the impact of the study on the regular timetable of participants, the researcher discussed this issue with teacher participants. Students who did not opt in attended lessons as usual but were not asked to

fill in questionnaires at the end of lessons. To prevent children who did not participate in the research from feeling they were excluded, prior to the research, the researcher discussed with teachers about the activities that children could do during the research time (e.g., complete the follow-up exercise for that lesson as general lessons).

Given that one of the aims of this study was to investigate the relationship between teachers and target students, teachers were asked to select students they were involved relatively more and less with in previous lessons (without students' personal details). To guard against a situation that might cause discomfort for participants or influence the interaction between teachers and students, the researcher explained the purpose of the research and discussed with teachers the importance of not changing the way they interact with their students because of the study.

All data collected about individuals were anonymised to ensure confidentiality based on the Code of Human Research Ethics by the British Psychological Society (British Psychological Society, 2014, 2021), the Data Protection Act (2018), and the data protection protocol of the code of ethics for education field in Taiwan. Participants' responses were kept confidential; no one would know the identity of either teacher participants (e.g., their colleagues or the head teacher) or student participants (e.g., their classmates, parents, or teachers) based on the responses. All participants were informed

that they were free to withdraw from the study at any time without adverse consequences. All data were entered only by the researcher, and all personalised information was removed from the dataset to ensure anonymisation.

4.8 MEASURES

The questionnaire in the whole project included a variety of measures of teacher teaching and student learning in school settings that went beyond the scope of the thesis[7], but only measures relevant to the studies presented in this thesis are described in this section (see Appendix D for questions or sample questions used in this thesis). First, teachers' and students' lesson-specific emotions (positive emotions, negative emotions) and teachers' perceptions of student behaviour (engagement and disruptive behaviour) were assessed. In addition, teachers' daily reflections on their well-being regarding teaching (work-related well-being) were assessed. Individual-level teacher variables such as teachers' beliefs about interpersonal harmony, their perceptions of teacher-student relationships, and their general well-being were examined. Finally, teachers' and students' demographic information such as gender, age, teaching experiences, students' social economic status, and students' academic performance were

[7] The whole project also included measures from the perspective of students, such as teacher-rated and student-rated teacher support in lessons, student-rated in-class engagement, student-level general well-being, and teacher-level psychological well-being.

included. All the assessments in the current study either have an existing Mandarin version or were back translated to Mandarin. The back translation process in this research included: forward translation from English to Mandarin, back translation from Mandarin to English, and evaluation and comparison of the translations (Brislin, 1970; Tyupa, 2011). A summary of the main measures (emotional aspect and student behavioural aspect) incorporated in each study is presented in Table 4. The reliability and validity of the measures will be discussed in the next section.

Table 4 *Overview of the main measurements*

Emotional aspect			
Teacher ratings		Student ratings	
Teacher emotions	Study 1- Study 3	Student emotions	Study 2
General well-being (life satisfaction)	Study 1	Perceived teacher emotions	Study 2
End-of-working day well-being	Study 1		
Morning well-being	Study 1		
Student behaviour			
Perceived student disruptive behaviour	Study 1		
Perceived student engagement	Study 1(single item) Study 3		
Teacher-student relationship	Study 3		

4.8.1 Measures of lesson-specific experiences

4.8.1.1 Emotions

Measures of momentary emotions in the studies contain three aspects: teacher emotions (Study 1-3), student emotions (Study 2), and student-perceived teacher emotions (Study

2). Emotions were measured using eight items incorporating the categories and wording of academic emotions in previous research (Becker et al., 2014; Y.-F. Chang & Cherng, 2017; Pekrun, 2006; Pekrun et al., 2002, 2007) and based on the pilot on primary school teachers and students in Taiwan. To lower the burden on participants, each emotion was assessed with a single item, with four items for positive emotions (enjoyment, relaxation, pride, and calmness) and four items for negative emotions (anger, anxiety, disappointment, and boredom). Furthermore, to avoid the problem of including only high arousal emotions, high and low arousal positive and negative emotions were equally selected in the research (McManus et al., 2019). An example item of teacher emotions is: “I felt relaxed”). To ensure the comparability of teacher emotions and student emotions, parallel item wordings were applied to assess student emotions (e.g., “I felt relaxed”) and perceived teacher emotions (e.g., “my teacher was relaxed”). All items were answered using a Likert scale ranging from 1 (not at all) to 5 (very much).

4.8.1.2 Perceived student disruptive behaviour

In Study 1, perceived student disruptive behaviour was included in the analysis. Three items (e.g., In this lesson, to what extent did students disturb the instruction?) adapted from previous research were used to assess teachers’ perceptions of overall student disruptive behaviour during the teaching session (Aldrup et al., 2018; Kunter &

Baumert, 2006). All items were answered using a Likert scale ranging from 1 (not at all) to 5 (very much).

4.8.1.3 Student engagement

In Study 1, student engagement was measured with a single item (To what extent did students engage in this lesson?) concerning teachers' perceptions of overall students' engagement in the classroom. In Study 3, student engagement was assessed with 8 items using a modified version of the student emotional engagement (e.g., This student was enthusiastic) and the student behavioural engagement (e.g., This student participated in discussions) subscales from Wellborn (1991) and Skinner et al. (2009). Behavioural engagement assesses students' actions and effort during the lesson, and emotional engagement assesses students' interest and vitality during the lesson. All ratings were given on a 5-point Likert scale ranging from 1 (not at all) to 5 (very much).

4.8.2 Day-level Measurement

4.8.2.1 Morning well-being

In Study 1, a single item ("Did you sleep well last night") was included to assess teachers' sleep quality. Another single item ("I felt tired this morning when I had to face another day at work") was included to assess teachers' tiredness and exhaustion levels in the morning (Maslach et al., 1997; Maslach & Jackson, 1986). These items are seen

as a reflection of teachers' daily well-being given that they assess an important aspect (recovery) of their state in the morning (Gluschkoff et al., 2016; Kiltz et al., 2020).

4.8.2.2 End-of-working well-being.

In Study 1, teachers' end-of-working well-being (i.e., teachers' daily work-related well-being) was measured by several indicators such as work enjoyment, work buoyancy (being able to deal with challenges at work), and work disengagement at the end of their teaching work each day on a 5-point Likert Scale. Work enjoyment was measured with four items adapted from Martin (2009), work buoyancy was measured with four items adapted from Martin and Marsh (2008), and work disengagement was measured with three items adapted from Martin (2010). Teachers reported their work enjoyment, work buoyancy, and work disengagement at the end of each working day on a 5-point Likert scale. Teachers' emotional exhaustion was measured with eight items from the Emotional Exhaustion subscale of the Maslach Burnout Inventory for Educators, which was adapted to assess teachers' daily emotional exhaustion level (Maslach et al., 1996; Maslach & Jackson, 1986). Teachers were asked to report to what extent they agreed with each statement on that day on a scale ranging from 1 ("strongly disagree") to 5 ("strongly agree").

4.8.3 Individual-level Measurement

4.8.3.1 Teachers' general well-being

Teachers' general well-being refers to their general evaluation of life, namely life satisfaction, in this research. Teachers' life satisfaction was measured at the start of the research period and at the end of it using paper-and-pencil self-report. Teachers were asked to rate their satisfaction concerning their lives as a whole. The measure was adapted from the Satisfaction with Life Scale (SWLS) to include the evaluation of one's life as a whole (Diener et al., 1985). The present instrument consists of five items rated on a five-point Likert scale (1 = strongly disagree; 5 = strongly agree). Teacher general well-being was included in Study 1 in this thesis.

4.8.3.2 Harmony belief

Teachers' beliefs about interpersonal harmony were measured with nine items from the short version of the Harmony Beliefs Scale (Lu et al., 2001; Lu & Gilmour, 2004). In the first paper-and-pencil questionnaire phase, teachers were asked to rate interpersonal harmony statements that were created according to Chinese idioms on a five-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree). High scores indicate a high level of belief in interpersonal harmony. Teachers' harmony belief was included in Study 1 in this thesis.

4.8.3.3 Teacher-student relationship

In Study 3, the teacher-student relationship was measured with 15 items from the short form of the Student-Teacher Relationship Scale (STRS, Chen, 2012; Pianta, 2001; Pianta & Steinberg, 1992). Responses were made on a five-point Likert Scale, ranging from 1 (definitely does not apply) to 5 (definitely apply). The STRS includes two subscales examining teachers' perceptions of closeness (8 items) and conflict (7 items) with individual students. The closeness scale measures the extent to which the teachers feel they have a warm, affectionate, and communicative relationship with the student (Pianta & Stuhlman, 2004). The conflict scale measures the degree of negativity a teacher feels toward the student (Pianta & Stuhlman, 2004).

4.9 RELIABILITY AND VALIDITY

The present study collected teacher participants' and student participants' self-reports to measure situational emotional experiences, well-being, perceived student behaviour, and teachers' general beliefs (e.g., harmony belief). As emotional experiences reflect an individual's appraisal or judgement, it is necessary and valuable to use the self-report method to understand the subtle part of human emotional elements (Pekrun, 2016; Schwarz, 2012). Retrospective bias is one issue that could arise from using the self-report method. To minimise the retrospective bias but reduce potential disruption to

teaching and learning, this study adopts a micro-longitudinal design with the EMA method to collect repeated measures data at the end of each lesson.

To ensure the validity of the research, some steps have been taken before and during the research process. Research suggests that participants' lack of compliance with the ecological momentary assessment design is of concern, as the EMA design relies on participants to provide a sufficient number of repeated reports (Ram et al., 2017). To improve participants' compliance, the orientation sessions for participants (for both teacher and student participants) were delivered by the researcher in all classrooms so as to field all the questions or concerns from participants, increasing participants' comfort with electronic devices, and ensure that there were no questions in the questionnaire that were difficult for participants to answer. To reduce the need for any outside support related to report completion while minimising any disturbance caused by issues related to wi-fi connection, the electronic questionnaire was set up so that it could be answered without an internet connection.

To alleviate the effect of participants' reactivity and social desirability on data collection procedures on ecological validity, questions about participants' emotional experiences appeared at the beginning of the questionnaire (French & Sutton, 2011). This could help to decrease the impact of other questions and retrospection on emotion

ratings (e.g., French & Sutton, 2010). The researcher also explained the whole procedure to participants beforehand, which included ensuring that participants were aware of the anonymity and confidentiality of the information gathered in the study, in order to encourage participants to respond to the questionnaire with their true thoughts.

After data collection, the reliability and construct validity of the measurements were tested. The examination of reliability and validity for the measures in this research is presented below.

Reliability

The reliability of each measure in this thesis was tested before the main data analysis to examine the internal consistency of teacher and student self-reports using both Cronbach's alpha and McDonald's omega (ω) at multiple levels (please see Appendix E for the reliability coefficient at different levels). For multilevel reliability, Cronbach's alpha (can be calculated from aggregated scores) and omega coefficients (can be calculated based on the multilevel confirmatory factor analysis approach) are commonly used to examine the internal consistency of psychometric reliability[8] (Jebb et

[8] Note that apart from psychometric reliability in multilevel models, aggregate reliability (e.g., ICC(1) and ICC(2)) can be used as interrater reliability to evaluate the within-group score regarding data aggregation, which is only applicable to certain models, such as direct consensus and referent-shift consensus composition models (Bliese, 2000; Jebb et al., 2019). A significant ICC(1) (also known as ICC) and higher ICC(2) represent acceptable between-cluster or group-level reliability (Lüdtke et al.,

al., 2019). In Study 1, all measures came from teacher reports. Lesson-level measures (teachers' positive and negative emotions, teacher-perceived student disruptive behaviour) were examined in a 3-level structure (i.e., lesson nested within days nested within teachers). Day-level measures (i.e., end-of-working well-being) were examined at the day and teacher level (2-level structure). The teacher-level measure (i.e., teacher general well-being) was examined at the teacher level. In Study 2, apart from the same measure of teacher emotions as in Study 1, the add-in student reports (i.e., student emotions and student-perceived teacher emotions) were examined in a two-level structure (lesson nested within student) with each lesson being nested within students and each lesson being nested within teachers. Last, in Study 3, teacher-reported individual student engagement was examined in a 3-level structure (lessons nested within students nested within teachers).

The acceptable range of Cronbach's alpha as internal consistency is usually considered to be 0.60 or 0.70 (Bernardi, 1994; Ponterotto & Ruckdeschel, 2007). Overall, Cronbach's alpha for teacher reports in all three studies ranged from 0.75 to

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2009; van Mierlo et al., 2009). ICC(2) can be calculated through ICC(1). However, ICC(2) is sensitive to the value of ICC(1) and group size, especially if ICC(1) values are low or/and the group size is small (Bliese, 2000; van Mierlo et al., 2009). In this thesis, all ICC(1) was significant, and the information on ICC (ICC(1)) was presented in each manuscript.

0.99 (Cronbach's alpha), and the α coefficient of student reports at multiple levels ranged from 0.68 to 0.87. The Cronbach's alpha for all constructs in this research was higher than the criteria of 0.60.

McDonald's omega (McDonald, 1999),[9] which was calculated based on the results of factor models using common and unique variance, represents the ratio of the true-score variance of a variable (sum of the true-score variance) to the total variance (true-score variance and error variance) of it. Omega coefficients are seen as a more realistic indicator of internal consistency compared to other indices, such as Cronbach's α, as they are less likely to overestimate or underestimate the reliability (Dunn et al., 2014; Zinbarg et al., 2005). By calculating the ratio of the estimated true-score variance to the total variance at different levels (e.g., within-level and between-level), McDonald's Omega reflects that level-specific reliability is suitable for multilevel data (Geldhof et al., 2014). Based on previous studies, although there is no universal cut-off for McDonald's omega, it is suggested that the minimum would be greater than 0.50 (Reise et al., 2013). In this research, the range of the McDonald's omega of teacher reports ranged from 0.58 to 1.00, and the McDonald's omega of student reports ranged

[9] The omega can be estimated by: $\omega = (\Sigma\lambda j)^2/[(\Sigma\lambda j)^2 + (\Sigma\Psi_j^2)]$

Where, $\Sigma\lambda j$ is the sum of factor loadings, and $\Sigma\Psi_j^2$ is the sum of error variance.

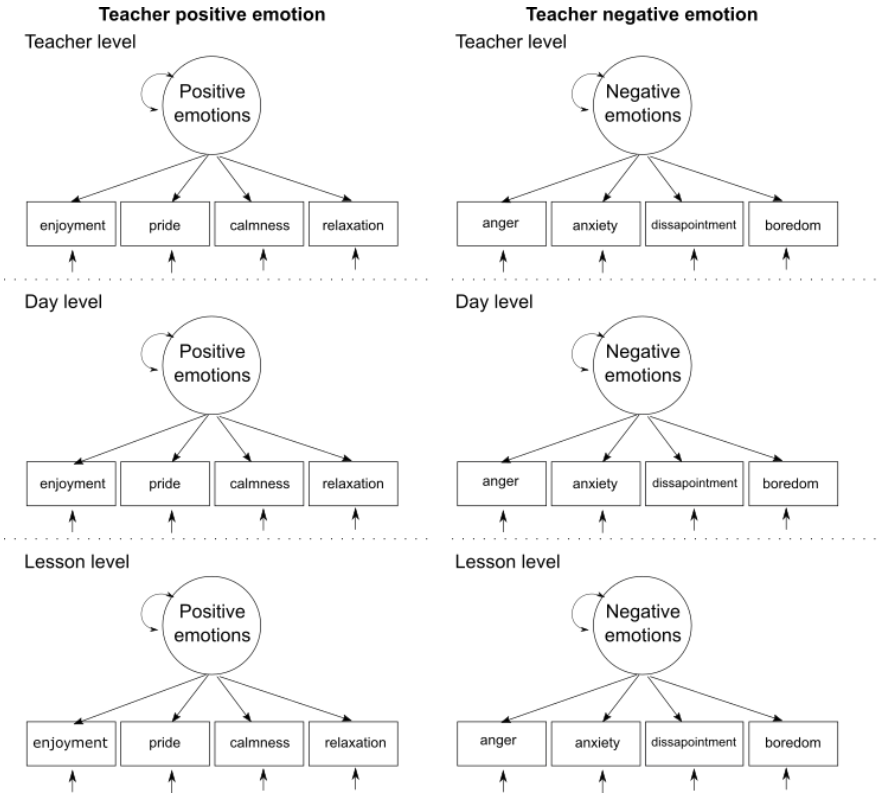
from 0.61 to 0.93. In all three studies, no omega coefficient of the constructs falls below 0.50.

Validity

Construct validity was examined prior to the main analysis. As this study used a micro-longitudinal design with ecological momentary assessment that has nested dataset characteristics, considering the complexity of models, the flexibility of requirements (balanced or non-balanced data) and the integration of different sources (teacher reports and student reports), the main analysis of the studies presented in this thesis employs the concept of latent structures. Thus, construct validity was examined using multilevel confirmatory factor analysis (MCFA) with Bayesian estimation (please see more details in section 4.10 regarding Bayesian estimation applied in this research).

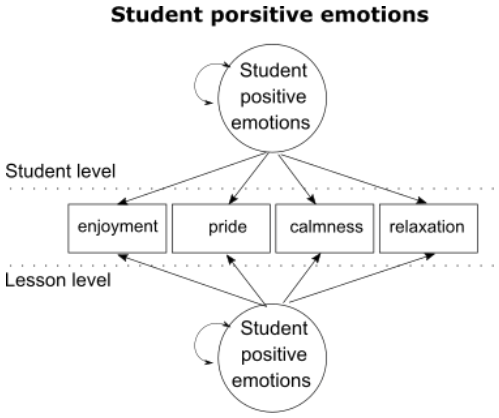
In Study 1, three-level MCFA models were conducted to examine the main lesson-specific measures: teacher-reported momentary positive and negative emotions (see Figure 6 for the example structure of the 3-level MCFA models). In addition, two-level models were tested to examine day-level measures (e.g., daily measurement of end-of-working well-being), as well as a single-level model for teachers' general well-being and harmony belief. Similarly, analyses of three-level MCFA models for teacher-perceived student engagement (teacher report) were conducted in Study 3.

Figure 6 *Three-level multilevel confirmatory factor analysis structure (Study 1 and 3)*



In Study 2, two-level MCFA models were tested for the add-in student measures (e.g., student emotions, student-perceived teachers' emotions) for basis examinations (please see Figure 7 for the example structure of 2-level MCFA models) as the nature of the measure could also be seen as two levels (lesson nested in students) in this research (For details of MCFA results please see Appendix F).

Figure 7 *Two-level multilevel confirmatory factor analysis structure (Study 1 and 2)*



4.10 DATA ANALYSIS

This section provides an overview of the analytical approach and analysis methods employed in the studies presented in this thesis. Data management and initial data quality control was carried out in SPSS (version 27 and 28)[10]. Tests of structural validity and models for answering substantive research questions were specified in Mplus (L. K. Muthén & Muthén, 1998-2017; version 8.4). Overall, the intraindividual approach was used and the multilevel structural equation modelling framework was employed in all studies. The nuanced analyses that were conducted on the data in this thesis are discussed below.

[10] The initial data quality control process was based on several criteria for multiple reporters. For details, please see Appendix G.

4.10.1 Intraindividual approach

As discussed in section 4.2, in this research a micro-longitudinal design (intraindividual design) with the ecological momentary assessment to collect repeated data based on lessons for gaining dynamics of emotional experiences in the classroom was employed (Hamaker & Wichers, 2017). Thus, an intraindividual analysis approach (within-person approach) was adopted for the data analysis process.

Interindividual (between-person) and intraindividual analysis are two common analysis approaches in current psychological research (Voelkle et al., 2014). Most educational studies, to date, have used an interindividual approach to investigate the relations between variables in cross-sectional or longer-term longitudinal studies. The interindividual analysis approach concerns the relations between variables across people, allowing researchers to compare differences measured between individuals. For example, in a single-level analysis, the interindividual approach examines whether teachers with higher levels of positive emotions have lower levels of negative emotions compared with other teachers. That is, the unit of the interindividual analysis approach is individuals, such as teachers (Murayama et al., 2017). In contrast, the intraindividual analysis approach takes various time points or situations as the analysis unit, and the analysis examines the relations between variables across situations within a person

(Murayama et al., 2017). An intraindividual approach analysis addresses psychological processes, such as emotions, by focusing on a sequence of events occurring in real life (Hamaker, 2012).

It is important to understand teachers' emotional experiences based on an intraindividual approach by virtue of the fact that it illustrates the emotional fluctuations that occur within an individual (Murayama et al., 2017). The intraindividual approach analysis was used in this research applying multilevel structural equation modelling, which is discussed in the following section.

4.10.2 Multilevel structural equation modelling framework

A multilevel structural equation modelling (MSEM) framework was used to analyse the data throughout the studies. MSEM is the combination of structural equation modelling and multilevel analysis. Structural equation modelling (SEM) is a technique that evaluates complex multivariate relationships accounting for means, variances, covariances, and errors of a set of dependent and independent variables to test the pre-assumed model (Fan et al., 2016; Ryu & West, 2009). A full SEM model combines two parts: the measurement model (factor analysis) and the structural model (path analysis). The measurement model illustrates the relations between a group of observed variables and the assumed corresponding factors. The structural model illustrates the relationship

between latent variables. Multilevel structural equation modelling expands upon structural equation modelling and multilevel analysis, enabling the structure of relationships to be tested at multiple levels (Mehta & Neale, 2005). It is suitable for multilevel multivariate data and non-independent observations (Ryu & West, 2009). As multilevel structural equation modelling allows for formulating observed and latent variables as well as the relations between variables at different levels (Hox, 2013), it accommodates a wide range of interesting questions that require a relatively flexible setting.

MSEM allows for adding level-specific predictors and accommodating dependent variables measured at higher levels and could be specified by applying either multilevel regression models or structural equation modelling, considering missing data and data balance issues (Rabe-Hesketh et al., 2007). Thereby, MSEM allows researchers to examine bottom-up effects/micro-macro effects in a hierarchical dataset (Preacher et al., 2010). Thus, compared to traditional multilevel modelling (MLM), which only allows a Level-1 outcome variable, in MSEM, a Level-1 (bottom/micro) variable can predict a Level-2 (up/macro) outcome variable. As the present research aimed at investigating teachers' momentary emotional experiences as a process and the

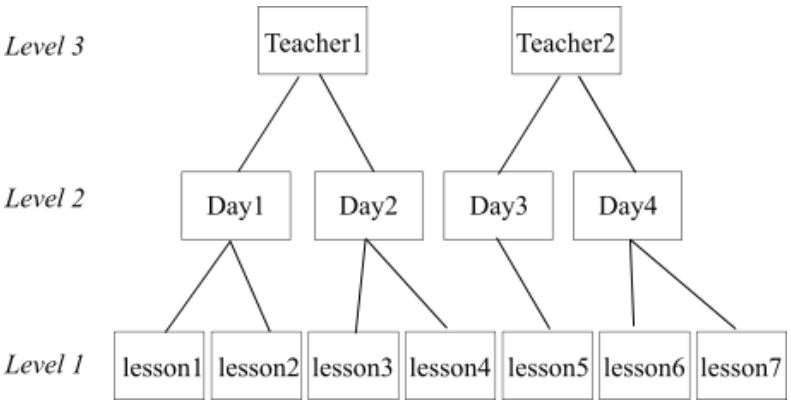
reciprocal relationships between teacher and student emotions, the nested data structure fits the multilevel structural equation modelling framework.

In the framework of MSEM, the three studies used different analysis models to answer the research questions. Study 1 specified 3-level path models with scale scores in the multilevel structural equation modelling framework (see Figure 8 for 3-level data structure). Study 2 specified cross-lagged models (with cross-classified structure) to examine the reciprocal relationships between teachers' and students' momentary emotions (see Figure 9 for cross-classified structure). Study 3 used a wide format of dataset (please see Chapter 7 Figure 21) to analyse the dyadic relationship between teachers and students. The underlying concept of using a wide dataset format is explained as below.

People as variables. According to Mehta and Neale (2005), it is possible to reframe a univariate multilevel model as a single-level restricted CFA model (confirmatory factor analysis model, fixed factor loadings according to the design), as multilevel structural equation modelling is a variant of it. Thereby, individual scores could be seen as separate variables. In this sense, a three-level multilevel model with a time structure (e.g., time points nested in students nested in teachers) is possibly seen as a two-level model (Mehta & Neale, 2005). In the same vein, in Study 3, a wide dataset

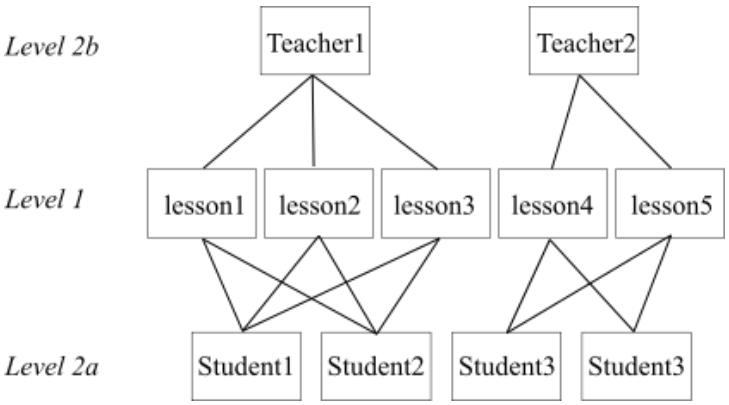
was used to reconceptualise the three-level structure into a two-level structure to investigate the dyads between target students and teachers.

Figure 8 *Three-level data structure*



Note. Three-level data structure was used in Study 1. Teacher-reported lesson-specific data nested with their day-specific data nested within teachers.

Figure 9 *A cross-classified data structure*



Note. Cross-classified data structure of Study 2, with lessons both nested within students and teachers.

4.10.3 Bayesian estimation

Bayesian estimation was incorporated with MSEM to analyse the data in this research. To date, Null Hypothesis Significance Testing (NHST, also called Null Hypothesis Statistical Test) has been the most commonly used statistical approach. As the name of NHST suggests, it tests against a posed null hypothesis based on the given data. A decision to accept or reject the null hypothesis is made based on a predetermined threshold (level of significance; p-value). Based on different underlying philosophical perspectives, Bayesian estimation estimates the probability of the parameters depending on the given data. Instead of using the p-value as the cut-off point for decision-making, Bayesian estimation treats the null value based on the certainty in the estimation and provides rich information (Kruschke, 2013).

Based on the Bayes theorem, one characteristic of Bayesian estimation is that it does not rely on large-sample theory, which provides a more flexible way to analyse the data, particularly suitable for complex multilevel models (Kruschke, 2013; B. Muthén & Asparouhov, 2012). Additionally, Bayesian estimation also has a better small-sample performance in multilevel models (B. Muthén & Asparouhov, 2012). In this research, the cluster at the highest level (teacher participants) is relatively small. Thus, Bayesian estimation is appropriate to use in order to get robust and accurate results from the

models (Hox et al., 2012). In Bayesian estimation, both non-informative prior and informative prior can be used. In this research, the default Bayesian (diffuse priors) estimation was used in Study 1, and admissible-range-restricted priors (weakly informative priors, McNeish, 2019) were used in Study 2 and Study 3.

A Posterior Predictive p-value (PPP) of model fit and the Deviance Information Criteria (DIC) can be obtained using Bayesian estimation. PPP is used to examine the model fit. A low PPP indicates poor fit (PPP < .05), whereas a PPP value around 0.5 indicates an excellent fitting. Diagnostic steps were adopted to examine the model's health. The Potential Scale Reduction value (PSR) with the criterion of 1.05 was set to inspect the convergence of the Markov chain Monte Carlo (MCMC) algorithm (Gelman & Rubin, 1992). The posterior trace plot was inspected to visualise the convergence of each parameter, and the autocorrelation plot was also used to detect the problems with the models. In Bayesian estimation, instead of p-value, 95% credible intervals (CI) were reported to interpret the estimated results.

4.10.4 Autoregressive and cross-lagged models

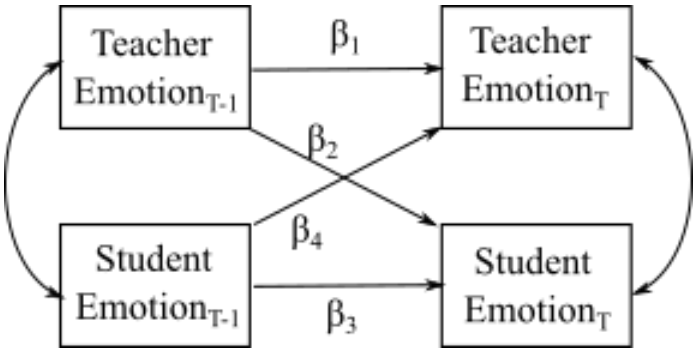
To investigate the stability of emotions and the reciprocal relationships between teacher and student emotions, autoregressive models (AR) and cross-lagged models integrating a multilevel structural equation modelling framework were used in Study 2.

Autoregressive models handle time series patterns. The autoregressive correlations or effects (see Figure 10, path β1 and β3) then depict the stability of an individual for a construct from the previous time point (T-1/T) to the current (T/T+1) time point (Selig & Little, 2012). The autoregressive coefficient ranged from -1 to +1. A substantial autoregression coefficient indicates that an individual's status on the construct changes by a relatively small amount across time (Gistelinck et al., 2021; Selig & Little, 2012). In contrast, an autoregressive coefficient that is zero or close to zero indicates an explicit change in the individuals' status on the constructs over time. The size of an autoregressive coefficient also refers to *emotional inertia* in an autoregressive model when studying emotional state, meaning the stability or the inert level of individuals' emotions (Voelkle & Wagner, 2017). If an individual's current emotional state (T) can be highly predicted by the prior emotional state (T-1), this indicates high inertia. High inertia means that a person's emotional state tends to persist, implying a lingering effect, carryover, or spillover effect (Kuppens et al., 2010). It also reflects a person who has a weaker regulatory mechanism and thus needs more time to recuperate (Hamaker, 2012). In contrast, low inertia (coefficient close to 0) reflects a person who is characterised by a strong regulatory mechanism and bounces back to the baseline faster. According to Hamaker (2012), a sizable positive

autoregressive coefficient indicates higher inertia that reflects a spillover effect from one time point to another, while a negative autoregressive coefficient could connote a compensatory action. In this research, autoregressive models were used in Study 2 to investigate the stability of constructs such as teachers' and students' momentary emotions from one lesson to another.

Cross-lagged models were also used in Study 2 to examine and describe the reciprocal relationships (Selig & Little, 2012). Expanding the autoregressive models, cross-lagged models add on the cross effect from two variables (e.g., X and Y) at different time points (e.g., T-1, T). In other words, cross-lagged models allow researchers to examine the direction of the effect (e.g., X_{T-1} predicts Y_T and Y_{T-1} to X_T) and to examine a loop of responses over repeated measures (Lilly, 2020). This allows the investigation of the reciprocal relationships between teacher emotions and student emotions in Study 2. In addition, this allows the investigation of "the chicken or the egg?" questions such as "Do prior students' emotions predict teachers' emotions, or, conversely, do prior teachers' emotions predict subsequent students' emotions, or both?" in Study 2 (see Figure 10)

Figure 10 *Cross-lagged model structure of Study 2*



Note. β_1 and β_3 represent the autoregressive effect. β_2 and β_4 refer to the cross-lagged effect.

4.11 SUMMARY

This chapter provides a comprehensive illustration and interpretation of the overall research design, procedure, and measures used in each study. The overall research framework guided the research aims of the studies presented in this thesis and provided a clear link among the studies. For the overarching aims of this research, both teacher and student data were collected in Taiwanese primary schools and analysed using the MSEM framework. A summary of the main aims, participants and the primary analysis methods used in each study is shown in

Table 5. In the following three chapters, each study (Manuscript 1-3) will be presented as a complete manuscript in its own right to address the different aims and research questions of this research.

Table 5 *Summary of the main aims, participants and data analyses used in each study*

Study	**Main aim**	**Participants**	**Data analyses**
Study 1	To investigate teachers' emotional experiences, perceived student behaviour, their day-to-day work-related and general well-being	Teachers (N=20)	MSEM (3-level)
Study 2	To examine emotional contagion and its directionality between teachers and students	Teachers (N=20) and students (N=306)	MSEM • Autoregressive • Cross-lagged
Study 3	To examine perceived individual students' engagement and teachers' emotions in teacher-student dyads	Teachers (N=20) and target students (N=80)	MSEM • Wide data format (people as variables)

CHAPTER 5. STUDY 1

Teacher well-being in the classroom: A micro-longitudinal study

The study underlying this chapter has been published in the journal *Teaching and Teacher Education.*

Li, P.-H., Mayer, D., & Malmberg, L.-E. (2022). Teacher well-being in the classroom: A micro-longitudinal study. *Teaching and Teacher Education*, *115*, 103720. https://doi.org/10.1016/j.tate.2022.103720

The contributions of each author (author statement, CRediT) to the article are stated in Appendix H

Please see Appendix I for the original paper

ABSTRACT

Given the high stress and attrition rate among teachers, there is a need to expand knowledge on situational experiences that contribute to teacher well-being. We investigated the links between student lesson-specific behaviour (disruptive behaviour, engagement), teachers' lesson-specific (positive, negative) emotions, daily (morning and end-of-working), and personal general well-being of 20 Taiwanese primary school teachers using a micro-longitudinal approach. By specifying multilevel structural equation models (MSEM), we found student behaviour predicts teachers' lesson-specific emotions, and this association varied across days and teachers. Teachers' lesson-specific positive emotions predict teachers' well-being, suggesting positive emotions can be a protective factor for teachers.

Keywords: Teacher well-being; Academic emotions; Student disruptive behaviour; Student engagement

5.1 INTRODUCTION

Research has shown that teaching is a high-stress profession, in which burnout is a prevalent phenomenon (Aloe et al., 2014; Burić et al., 2019; Pillay et al., 2005). With the increasing research interest in the topic of teacher well-being in recent years, teacher well-being has been recognised as a significant factor for students' well-being, student learning outcomes (Frenzel et al., 2018; Harding et al., 2019; Jennings & Greenberg, 2009; Roffey, 2012), and teachers' commitment to their teaching career (C.-P. Chang et al., 2017). Yet, many studies mainly focus on the "dark side" of teacher well-being (e.g., exhaustion, burnout, or turnover rate) using the between-individual approach (Hagenauer et al., 2015; Simbula, 2010), and little is known about what contributes to teachers' well-being considering the classroom context where teachers interact with students in real-time, from one lesson to the other, day to day.

Insight into the dynamic (e.g., daily ups-and-downs) mechanism of teacher well-being in the classroom has far-reaching implications for creating a positive classroom climate and intervention applications. Teacher well-being, identified as organised at momentary and personal levels (Nettle, 2005) and proven to be changeable (Diener et al., 2017), could be manifested by its momentary feelings, namely emotions, such as joy (also referred to as "discrete emotions"). If teachers' situational experiences and

momentary emotions in the classroom are shown to play an important role, programmes and strategies could be tailored to focus on how to support teachers in the school settings. Although momentary emotions are the situational form of well-being and contribute to one's satisfaction, it is not simply the sum of the positive emotional experiences minus the negative emotional experiences. To date, research on teacher emotions and teacher well-being is relatively fragmented concerning this process and how it relates to teachers' experiences in the classroom (Carson et al., 2010; Diener et al., 2017). Only a few studies have focused on two to three discrete teachers' emotions or the antecedents of teacher well-being in class using the momentary method (see Becker et al., 2015; Frenzel et al., 2015).

Given the relatively limited understanding of teachers' momentary experiences and their relation to their well-being, this study aims to examine our modified teacher well-being model and goes beyond previous cross-sectional and longer-term longitudinal studies to investigate teacher well-being from a micro perspective. To this end, we investigated the relationship between situational in-class antecedents (students' behaviour: disruptive behaviour and engagement) and teachers' momentary emotions in real-time classroom experiences and then explore whether teachers' emotions can predict their day-level and personal general well-being. Therefore, we employed a

micro-longitudinal study method with multiple assessments over lessons. A micro-longitudinal approach (e.g., experience sampling, momentary ecological assessment) reduces recall biases as it measures in-class behaviour and emotional elements directly at the end of each lesson. Moreover, it can elucidate and assess the micro-process of teacher well-being in an ecological context, enhancing contextual closeness (Bolger & Laurenceau, 2013; Hamaker, 2012; Hamaker & Wichers, 2017).

5.1.1 The context of teaching in Taiwan

This study investigated teacher well-being in Taiwan. Teaching and education in Taiwan are largely influenced by Confucianism. Education is not a personal pursuit but related to social obligations, and teachers are expected to meet the social expectations of their roles and moral standards (Yen & Hwang, 2011). In other words, teaching in Taiwan is a calling in which teachers transmit knowledge, share a philosophy of life, are role models for students, and devote themselves to education. Therefore, teachers are under scrutiny by the public regarding their teaching skills and conduct. As a result of the large education reform in 2001, called the Grade 1-9 Curriculum Reform, primary school teachers' roles have experienced a tremendous change. Teachers' status and authority have been reduced, the importance of interpersonal relationships and communication has risen, teaching methods have become more varied and complex,

and the requirements for teachers' expected characteristics have become higher (Guo, 2006). As a result, teachers are feeling more stressed because of the higher expectations from society (Guo, 2006).

Primary education is the first part of compulsory education in Taiwan. Public primary school homeroom teachers teach multiple subjects (e.g., Mandarin, Mathematics, Integrative Activity, and other subjects) and spend almost all their day with the same group of students in schools. They are also important role models for children. It is worth noting that according to the report from Campus Security Report Center (2017, 2018, 2019), a centre that is responsible for dealing with events and contingencies on campus, there is an increasing trend of self-harm and suicide cases in teachers in recent years. However, the understanding of how teachers' well-being is related to their in-class experiences is relatively limited. Therefore, it is important to understand teachers' real-time teaching experience and emotions with children, and how to promote or at least maintain teachers' well-being.

5.1.2 Theoretical underpinnings

To enable a holistic understanding of the dynamics of teacher well-being, this study used the multi-level structure to integrate different constructs of teacher well-being based on the broaden-and-build theory (Fredrickson, 1998) and the contributions of

previous studies regarding emotions and teacher well-being (e.g., Cohn et al., 2009; Frenzel, 2014; Spilt et al., 2011).

An emotion starts with an individual's conscious or unconscious appraisal of an antecedent event, which then triggers a series of response tendencies that can be observed through subjective experience, facial expression, cognitive processing, and physiological changes (Fredrickson, 2001). The broaden-and-build theory of positive emotions (Fredrickson, 1998) posits that in contrast to negative emotions, positive emotions broaden a person's momentary thought-action repertoire and further build various personal resources to deal with challenges (Fredrickson, 1998, 2013a). Negative emotions have been seen to narrow the attention of people (Fredrickson, 2013). They have the adaptive function of promoting specific actions, especially under immediate threats to survival. Unlike negative emotions, positive emotions benefit individuals' development and resource building through micro-moment accumulation in the long run. Additionally, positive emotions may loosen the aftereffects of negative emotions aroused by circumstances and further promote individuals' mental well-being and health (Fredrickson, 2013a; Fredrickson & Levenson, 1998).

Although interwoven together, positive emotions and negative emotions have their own respective self-perpetuating cycles (Garland et al., 2015). The cycle of

negative emotions narrows self-focus and leads to socially isolating thought-action tendencies, leading to subsequent negative emotions in turn. Thus, negative emotions trigger downward spirals. Positive emotions, on the other hand, trigger upward spirals by broadening individuals' mindsets and building resources, which in turn increase later positive emotions and enhance well-being and health. Upward spirals and downward spirals caused by positive emotions and negative emotions have significant differences in structure, not simply the opposite of each other. Despite the transient and fluctuating nature, positive emotions can have a long-term impact on enhancing well-being (Garland et al., 2010).

Empirical evidence supports the concept of the broaden-and-build theory that positive emotions undo or buffer the impact of negative emotions on detrimental physiological responses (e.g., Ong et al., 2006; Tugade & Fredrickson, 2004). Furthermore, positive emotions build resources, such as resilience and well-being (Cohn et al., 2009; Johnson et al., 2021; Nalipay et al., 2019), serving as indicators of optimal well-being (Fredrickson, 2001).

5.1.3 Unwrap teacher well-being

Teacher well-being, which captures teachers' professional fulfilment and happiness (Acton & Glasgow, 2015), is conceptualised as multifaceted with multiple layers

(Diener et al., 2017). The concept of well-being includes individuals' overall satisfaction, domain-specific well-being, and emotional experiences (Diener, 2000; Diener et al., 2017). Teacher well-being research frequently focuses on teachers' job satisfaction or assesses overall well-being, especially how individual traits and school factors are associated with teacher well-being (Bermejo-Toro et al., 2016; Collie & Martin, 2017; Fernandes et al., 2019; Tatalović Vorkapić & Peloza, 2015; Yildirim, 2014). However, based on the broaden-and-build theory (Fredrickson, 1998) and the insight from previous teacher well-being models (Cohn et al., 2009; Frenzel, 2014; Nettle, 2005; Spilt et al., 2011), momentary emotional experiences (positive and negative emotions) are first appraised by the antecedents, and power or depower personal resources. Then, momentary emotional experiences increase or decrease individuals' domain-specific well-being and then have an impact on their overall evaluation of life. We expanded previous research to modify well-being models and examined it by assessing the constructs separately with three time-specific levels (situation, day, person) and presuming that momentary positive and negative emotions predict teachers' daily work-related well-being. Further, the accumulation of emotions impacts their general well-being, namely their overall life satisfaction.

Growth in stress does not require an absence of positive emotions and increases in resources do not require the non-existence of negative emotions (Fredrickson, 2013a; Garland et al., 2010). Upward spirals caused by positive emotions and downward spirals caused by negative emotions are two distinctive cycle systems; thus, individuals could experience positive and negative emotions simultaneously in everyday life (Trampe et al., 2015). When a teacher is experiencing positive emotions in school settings, resources can be built to deal with the challenges from work or boost their positive evaluation of their teaching work. In contrast, when a teacher is experiencing negative emotions in school settings, this then contributes to a repeated cycle of negative emotions and leads to emotional exhaustion or less engagement in work. As the accumulation of positive and negative emotions, positive and negative emotions may have different impacts on domain-specific evaluations through their cycle systems and eventually lead to an increase or decrease in life satisfaction.

One function of positive emotions is the potential "undo effect," which indicates that positive emotions could help people recuperate from stress (Fredrickson, 2013a). We then proposed that positive emotions and negative emotions individuals experience during their work predict their daily evaluation of work-related (domain-specific) well-being differently. The accumulation of negative emotions leads to downward spirals and

mainly has implications for the negative evaluations of individuals' work. The accumulation of positive emotions leads to upward spirals and has implications for the positive evaluations of individuals' work, and it is protective in decreasing the negative evaluations of their work. In turn, the accumulation of emotions leads to an increase or decrease in general evaluations of life. Our statistical methodology enabled us to take account of these complex associations at the situational, daily, and personal levels.

5.1.4. Teacher emotion in class

Pekrun et al. (2002) pointed out that the emotions experienced during learning and instruction in school settings can be categorised as academic emotions. Chang and Cherng (2017) indicated that teachers, similar to students, have academic emotions regarding teaching, such as enjoyment, pride, and anxiety. Thus, students experience academic emotions from a learning aspect and teachers experience teaching emotions from lesson to lesson.

Research on teachers' emotions, especially teachers' emotional regulation, is not new (Jiang et al., 2016; M. Lee et al., 2016). These studies have investigated teachers' emotional management strategies. However, as Frenzel (2014) argued, existing literature is mainly based on interviews and not many studies have explicitly focused on teachers' emotions. Research that focuses on teachers' academic emotions, unlike

students' emotions in school (Goetz et al., 2013; Pekrun et al., 2011; Schutz, 2014), is even more scarce. The existing body of literature has largely reported specific emotions instead of exploring multiple or general positive and negative emotions. The most common emotions used to investigate teachers' teaching emotions are enjoyment, anger, and anxiety. However, evidence has shown that teachers may also experience other emotions, such as pride and disappointment during teaching (Brígido et al., 2013; Prosen et al., 2011).

Research on emotions assumes that teachers' emotional experience has an impact on their well-being, especially occupational well-being. According to Fredrickson (2013), negative emotions are distinctive in their adaptive value, while positive emotions broaden a person's mindset and enhance one's well-being. However, less is known about how teachers' lesson-specific emotions are associated with their well-being and exhaustion.

5.1.5. Student behaviour as an antecedent of teacher emotions

Teachers' emotions are likely to be evoked in interaction with their students in class. Appraisal theory suggests that individuals' emotions are triggered by situations or events but caused by individuals' judgement about situations. In Frenzel's model, teachers' perceptions about student behaviour shape their emotions in class (Frenzel,

2014). In a momentary class situation, student behaviour such as their motivational behaviour (student engagement) and social-emotional behaviour (abide by the rules, student disruptive behaviour) may be the most obvious for teachers. When teachers perceive a higher level of student engagement that is consistent with their goals, they may experience positive emotions such as enjoyment. Conversely, if teachers perceive a low level of student engagement that is inconsistent with their goals, they may experience negative emotions such as anger. Additionally, when students misbehave in class, teachers may experience negative emotions such as anger or anxiety.

Empirical studies have provided some evidence that teachers' emotions are related to students' positive and negative behaviour in class, especially the connection between student disruptive behaviour and teachers' negative emotions. Student disruptive behaviour or lack of discipline is a key factor that arouses teachers' negative emotions, evokes responses such as anger or anxiety (de Ruiter et al., 2020; Hagenauer et al., 2015), and reduces teachers' level of enjoyment (Becker et al., 2015). Additionally, student disruptive behaviour has also been found to be a factor further heightening the risk of teachers' exhaustion over time (Aldrup et al., 2018; Aloe et al., 2014).

Compared to research on teachers' emotions and students' disruptive behaviour, research on how positive student behaviour in class predicts teachers' emotions is sparse. In Austria, Hagenauer et al. (2015) examined the effect of students' motivational behaviour (engagement) on teachers' emotions, including enjoyment, anger, and anxiety. They indicated that students' engagement in class contributes to teachers' positive emotions. Frenzel et al. (2020) addressed four types of student attainments (performance, motivation, discipline, and relationship attainment) and found that student engagement predicts teachers' enjoyment and anxiety, while the necessity to discipline students predicts teachers' anger and anxiety. This indicates that student engagement is a positive predictor of teachers' positive and negative emotions.

The existing body of literature on teachers' emotions mainly focuses on limited emotions such as enjoyment, anger, and anxiety, but not a broader perspective that examines the entire range of positive and negative emotions (Frenzel, 2014). Interestingly, Becker et al.'s (2015) study revealed that teachers' positive emotions and negative emotions may be triggered through different pathways in which positive emotions were mainly induced by students' positive reactions in the class, while negative emotions were mainly induced by students' negative behaviour in the class.

Thus, an unresolved issue is whether students' disruptive behaviour lessens teachers' positive emotions while student engagement decreases teachers' negative emotions.

5.1.6. The present study

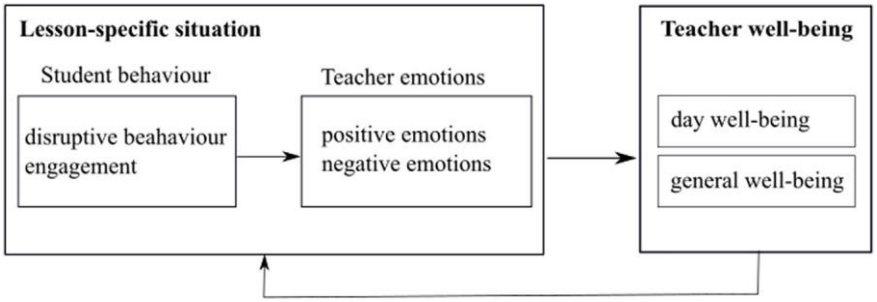
We posed a modified theoretical model of teacher emotions and well-being in the teacher-student interaction context (see Figure 11). In this model, teachers' perceptions of student behaviour in lessons link with their situational emotions (lesson-specific). Teachers' emotions then further link with their well-being, including their daily work-related well-being and general well-being. In this study, we aimed to investigate how teachers' moment-to-moment emotions are related to students' behaviour. Additionally, the relationship between teachers' lesson-specific emotions, teachers' end-of-working well-being, and general well-being was investigated. We posed the following research questions that guided this study:

1. Do students' lesson-specific disruptive behaviour and engagement predict teachers' lesson-specific emotions? (lesson level)
2. Does the association between students' disruptive behaviour and teachers' emotions vary across days and teachers?
3. Does the association between students' engagement and teachers' emotions vary across days and teachers?

4. Does teachers' morning well-being (sleep quality and tiredness) moderate the relationship between students' behaviour (disruptive behaviour and engagement) and teachers' emotions?
5. How do teachers' emotions predict teachers' end-of-working well-being and general well-being?

We expected that lesson-specific student behaviour (student engagement, student disruptive behaviours) would predict teachers' emotions in class, and that student engagement mainly predicts teachers' positive emotions positively while student disruptive behaviour mainly predicts teachers' negative emotions positively. Also, teachers' morning well-being (sleep quality and tiredness) would moderate the relationship between students' behaviour and teachers' emotions. Further, we expected that teachers' momentary emotional experience would predict their end-of-working day well-being and their general well-being. However, we also expected that the way that positive emotions and negative emotions predict teachers' well-being would be different to some extent.

Figure 11 *Theoretical model (Manuscript 1)*



5.2. METHOD

We conducted a quantitative micro-longitudinal study to address the research questions. By using the micro-longitudinal method, we could capture teachers' momentary experiences such as academic emotions (e.g., Becker et al., 2014; Goetz et al., 2013) and perceptions of behaviour (e.g., Becker et al., 2014) through a sequence of repeated measurements in the classroom while reducing retrospective bias (Bamberger, 2016; Bolger & Laurenceau, 2013; Hamaker, 2012). This section describes our sample, the measurements used, and the data analysis procedure.

5.2.1. Participant and procedure

In this study, participants were 20 homeroom teachers[11] (90% females) across eight public primary schools in Taiwan based on purposive and convenience sampling (see

[11] In primary schools in Taiwan, a homeroom teacher is attached to a certain homeroom of a group of students and in charge of looking after this group of students. Homeroom teachers teach multiple subjects, mainly including mathematics, Mandarin, and Integrative Activity.

Table 6). In Taiwan, the percentage of primary school female teachers is over 70%, and those who are homeroom teachers are approximately 80% (Department of Statistics, 2021). Thus, the number of male and female participants in this study to some extent reflected the gender proportion of teachers in primary schools in Taiwan. Teachers taught either Year 4 or Year 5[12] (45% taught Year 4 and 55% taught Year 5) and their ages ranged from 28 to 55 (M = 43.05 years, SD = 9.01 years). Their teaching experience ranged from 2 years to 30 years (M = 16.13 years; SD = 8.56 years). In total, 308 students (46.8% females) participated in the study with their teachers. 132 students were in Year 4, and 176 students studied in Year 5 (57.1%) with an average age of 10.39 years (SD = 0.66, Range = 9.08 to 12.25, n = 306). Students' average academic performance in Mandarin was M = 86.71 (SD = 10.36; Range 43–100, skewness = −1.24, kurtosis = 1.81) and Mathematics was M = 81.51 (SD = 14.80; Range 17–100, skewness = −1.39, kurtosis = 2.58). In general, Year 4 students perform better than Year 5 students in Mathematics (t = 5.76, p < .001) but not Mandarin (t = 1.32, p = .19.). Intraclass correlations showed that there were student-group differences in performance in Mandarin (ρ_{ICC} = 0.25) and mathematics (ρ_{ICC} = 0.30).

[12] Children start primary school at the age of 6 in Taiwan.

After obtaining university ethical approval, participants were invited through the headteacher to join the study for a calendar week during term time with written informed consent. An induction session was provided for each teacher in which the researcher fielded questions and the teacher filled in a brief paper-and-pencil questionnaire (n = 20) in order to understand background information and general well-being. Teachers were also instructed how to fill in the electronic day and lesson questionnaire on a tablet during the data collection period. They were asked to complete a morning questionnaire before starting work each morning and an afternoon questionnaire upon completion of each working day (90% compliance). Teachers were asked to report on each lesson during the last 5–10 min of each lesson or during the 10-min break afterwards if reporting during the lesson could not be completed. The median response time for completing lesson-specific questionnaires was less than 3 min (146 s). However, teachers were not always able to fill in the questionnaire during this interval because they were too busy with the students or the contingencies in the classroom. At the end of the research period, teachers filled in another brief paper-and-pencil questionnaire. All 20 teachers completed both paper-and-pencil questionnaires and electronic questionnaires. The feasibility of the procedure and the face validity of all measures were piloted prior to the main study. On average, teachers reported on 13.15

lessons (*SD* = 1.95; range = 9–16) for 4.5 days (*SD* = 0.61; range = 3–5) within the research period, giving 249 lesson-specific reports included in analysis in total.

Table 6 *Teacher and student characteristics (Manuscript 1)*

	Variables	*N (%)*	*M*	*SD*	Range	Skewness	Kurtosis
Teacher (n=20)	Gender						
	Male	2 (10.0%)					
	Female	18 (90.0%)					
	Age (year)	20 (100%)	43.05	9.01	28-55	−0.53	−1.17
	Teaching experience	20 (100%)	16.13	8.56	2-30	−0.22	−1.13
Student (n=308)	Gender						
	Male	164 (53.2%)					
	Female	144 (46.8%)					
	Grade						
	Year 4	132 (42.9%)					
	Year 5	176 (57.1%)					
	Age (year)	306 (99.4%)	10.39	0.66	9.08-12.25	0.04	−0.90

5.2.2. Measures

Measures in this study include questionnaires at three different levels (lesson, day, and teacher level). All measures were assessed on a 5-point Likert scale and are presented according to the different levels, as below.

Lesson-specific measurements

Student behaviour. Teachers reported their perceived student behaviour at the end of each lesson. In order to capture the positive and negative dimensions of student behaviour, we included student disruptive behaviour and student engagement. Drawing

on the concept of students' disruptive behaviour from Kunter and Baumert (2006), teachers were asked how often students show disruptive behaviour in each lesson in 3 items (e.g., "In this lesson, to what extent did students disturb the instruction?", Aldrup et al., 2018). For overall student engagement, we used a single item to assess student engagement ("To what extent did students engage in this lesson?") to understand teachers' perceptions during the short transition between lessons to reduce the burden on participants. Internal consistencies (Cronbach's α, 0.84 – 0.87) and McDonald's omega (ω, 0.66 − 0.89) at each level (lesson, day, teacher) of student disruptive behaviour are shown in Table 7.

Teachers' emotions. We select emotions to be examined in the present study based on some selection criteria. First, we wanted to examine discrete emotions that are particularly related to classroom settings based on existing research (Goetz et al., 2013; Pekrun et al., 2002, 2007). Second, we take the results of our pilot examination of the emotions that teachers and students have in the culture-specific context (Taiwanese primary school teachers and students) into account. Teachers' emotions in class were measured by eight positive and negative emotions. Enjoyment, relaxation, pride, and calmness were included to understand teachers' positive emotions, and disappointment, anxiety, anger, and boredom were included as negative emotions (Goetz et al., 2013;

Pekrun et al., 2002, 2007; Watson & Tellegen, 1985). Two positive (enjoyment, pride) and two negative emotions (anger, anxiety) are categorised as activating emotions, and others are deactivating emotions (Pekrun et al., 2007). For each emotion, to limit the administration time and lower the burden on participants, we used a single item (Frenzel et al., 2015). Teachers were asked to rate how much they agreed with the sentences (e.g., This lesson, I felt relaxed) about their emotions in each lesson on a five-point Likert Scale ranging from 1 (not at all) to 5 (very much). Internal consistency (Cronbach's α) and the McDonald's omega (ω) of positive emotions and negative emotions were between 0.59 and 0.92 (see Table 7).

Day-level measurement

Morning well-being. We included two indicators (sleep quality and tiredness) that reflect teachers' emotional exhaustion state in the morning labelled as morning well-being in this study for their potential effect on emotions (Hülsheger, 2016). These indicators complete the loop of teachers' daily work-related well-being. Teachers were asked to respond to two single items on a five-point scale indicating teachers' morning status. Sleep quality was measured with the item "Did you sleep well last night?" (1 = very bad, 5 = very good). Tiredness in the morning was measured with the item "I feel

tired this morning when I have to face another day at work" (1 = not at all, 5 = very much).

Teachers' end-of-working well-being. To understand teachers' domain-specific (work-related) well-being that covers both the positive and negative indicators, We integrated two negative and two positive work-related well-being that both reflect emotional-oriented (work enjoyment, burnout) and task-oriented (work buoyancy, work disengagement) according to the structure of previous research (for work enjoyment, buoyancy and disengagement, please see Collie & Martin, 2017; for emotional exhaustion, please see Maslach & Jackson, 1986). Teachers reported their work enjoyment in 4 items (e.g., "On the whole, I enjoy my work"; Martin, 2009), work buoyancy (capacity to deal with challenges effectively) in 4 items (e.g., "I think I'm good at dealing with work pressure"; Martin & Marsh, 2008), and their work disengagement in 3 items (e.g., "I've pretty much given up being involved in things at work"; Martin, 2010) at the end of their teaching work each day on a 5-point Likert Scale. The last element, emotional exhaustion, was measured with 8 items of the emotional exhaustion subscale of the Maslach Burnout Inventory (Maslach & Jackson, 1986). Teachers were asked to report the extent to which they agreed with each statement on that day (e.g., I feel emotionally drained from my work). Internal

consistencies (Cronbach's α from 0.75 to 0.97) and McDonald's omegas (0.58–0.99) at different levels are shown in Table 7.

Table 7 *Intercorrelations of variables (Manuscript 1)*

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
1. PE	1												
2. NE	-0.61***	1											
3. DB	-0.15*	0.28***	1										
4. EN	0.51***	-0.51***	-0.28***	1									
5. SQ	0.24***	-0.31***	0.01	0.16*	1								
6. TR	-0.29***	0.27***	-0.02	-0.19**	-0.43**	1							
7. WE	0.58***	-0.46***	0.03	0.42***	0.38**	-0.46***	1						
8. WB	0.65***	-0.48***	-0.11	0.40***	0.29**	-0.31***	0.80***	1					
9. WD	-0.39***	0.40***	0.15*	-0.27***	-0.15*	0.16*	-0.52***	-0.42***	1				
10. EE	-0.34***	0.55***	0.08	-0.46***	-0.39**	0.38***	-0.59***	-0.49***	0.39***	1			
11.PrLS	0.57***	-0.67***	-0.22***	0.37***	0.32**	-0.21*(*	0.50***	0.57***	-0.58***	-0.48***	1		
12.PoLS	0.43***	-0.40***	0.13*	0.28***	0.28**	-0.39***	0.72***	0.50***	-0.38***	-0.56***	0.50***	1	
13. HB	0.44***	-0.48***	-0.30***	0.22***	0.30**	-0.26***	0.31***	0.34***	-0.48***	-0.19**	0.80*(*	0.33***	1
M	3.62	1.86	1.51	3.97	3.57	2.21	3.81	3.86	1.56	2.13	3.91	3.79	3.93
SD	0.62	0.69	0.53	0.63	1.06	1.28	0.74	0.58	0.54	0.72	0.77	0.76	0.49
ICC(L1)	0.33	0.34	0.39	0.45	-	-	-	-	-	-	-	-	-
ICC(L2)	0.09	0.09	0.08	0.08	0.61	0.40	0.14	0.26	0.32	0.30	-	-	-
ICC(L3)	0.59	0.56	0.52	0.46	0.39	0.60	0.86	0.74	0.68	0.70	-	-	-
α/ω (L1)	0.76/ 0.59	0.82/ 0.67	0.84/ 0.66	-	-	-	-	-	-	-	-	-	-
α/ω (L2)	0.77/ 0.79	0.82/ 0.84	0.87/ 0.77	-	-	-	0.94/ 0.69	0.87/ 0.65	0.75/ 0.58	0.91/ 0.83	-	-	-
α/ω (L3)	0.85/ 0.88	0.87/ 0.92	0.87/ 0.89	-	-	-	0.97/ 0.99	0,96/ 0.98	0.85/ 0.89	0.95/ 0.96	0.94/ 0.95	0.93/ 0.94	0.89/ 0.86

Note: $^{***}p < .001$, $^{**}p < .01$, $^{*}p < .05$. PE = positive emotions, NE = negative emotions, DB = student disruptive behaviour, EN = student engagement, SQ = sleep quality, TR= tiredness, WE= work enjoyment, WB= work buoyancy, WD= work disengagement, EE = emotional exhaustion, PrLS = Pre-Life satisfaction, PoLS = Post life satisfaction, HB = harmony belief, α = Cronbach's α, ω = McDonald's omega

Teacher-level measurement

Teacher characteristics. We included a measure of teacher harmony belief adopted from Lu et al. (2001) as a covariate to understand teachers' interpersonal beliefs that comes from the cultural context (values interpersonal harmony). Teachers' harmony belief is seen as a predictor of well-being in Chinese culture (Lu et al., 2001). Teachers were asked to report on a five-point scale (1 = strongly disagree, 5 = strongly agree) to what extent they agreed with 9 harmony belief items to examine their culture-specific beliefs about interpersonal relationships (e.g., I believe that people should have self-restraint). Cronbach's α for harmony belief is 0.89, and the McDonald's omega (ω) is 0.86 (Table 7).

Teacher general well-being. To understand teachers' general well-being, the Satisfaction with Life Scale (SWLS) developed by Diener et al. (1985) to examine individual subjective well-being (life satisfaction) was used. Teachers were asked to respond on a 5-point scale (1 = strongly disagree, 5 = strongly agree) on the extent to which they agreed with five statements (e.g., "In most ways my life is close to my ideal") at the beginning and at the end of the research. Cronbach's α of SWLS are 0.94 and 0.95 at two assessments, and the McDonald's omega (ω) are 0.93 and 0.94 at two assessments (Table 7).

5.2.3. Data analysis

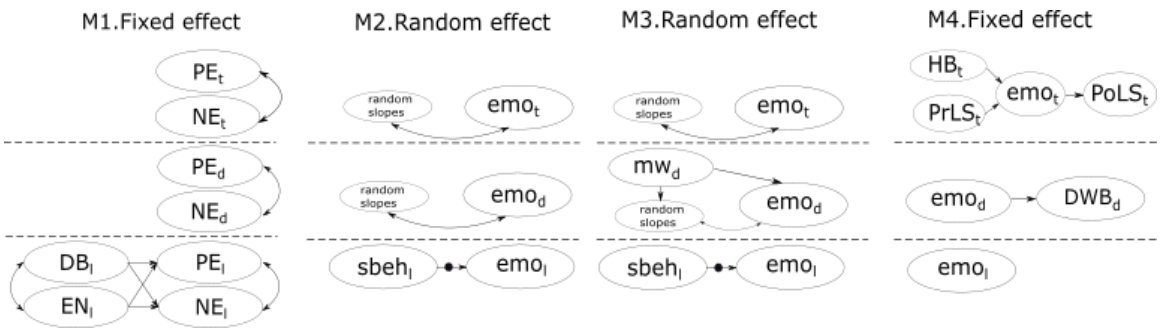
The data for this study were conceptualised as a three-level model; comprised of lesson-specific ratings at the first level (L1), between-day ratings at the second level (L2), and between-individual ratings at the third level (L3). The hierarchical data were analysed using the Bayesian estimator (Asparouhov & Muthén, 2020; B. Muthén & Asparouhov, 2012) under the framework of multilevel structural equation models (MSEM) in Mplus 8 (L. K. Muthén & Muthén, 1998-2017). We centred predictors specified at a certain level in fixed effect models at the grand mean (CGM), and centred predictors for random slope models at the group mean (CWC) to provide meaningful interpretations.

The Bayesian approach uses the probability distribution over hypotheses to estimate a model (P(hypothesis | data)) in contrast to null hypothesis testing in frequentist paradigms (van de Schoot et al., 2014). It better accommodates conditions (e.g., small sample size) that may lead to estimation problems in Maximum Likelihood (Hox et al., 2012; Zitzmann et al., 2016) which is suitable for the relatively small sample size (n = 20) in the present study. Using Bayesian estimation enables researchers to gain robust and accurate estimations of parameters in small sample size situations with diffuse priors (e.g., as few as 13 units at higher-level) or incorporate admissible-range-restricted prior (e.g., 15 units at higher-level with 25 timepoints at lower-level)

for multilevel SEM analysis (Hox et al., 2012; McNeish, 2019; Zitzmann et al., 2016). We specified uninformative prior for the parameters in this study (Heemskerk & Malmberg, 2020).

We started by investigating the variance components of emotions to evaluate how large variation in emotions could be attributed to the lesson (L1), the day (L2), and the teacher (L3). To answer the first research question 'Do students' lesson-specific disruptive behaviour and engagement predict teachers' lesson-specific emotions', we specified Model 1(M1) to analyse the fixed-effect of lesson-specific characteristics on teacher emotions. Following the fixed-effect model, we conducted a set of random intercept, random slope models (M2) to investigate whether there are day or individual differences in the association between student behaviour variables and teacher emotions (Research questions 2 and 3). We then investigated the potential cross-level interaction based on the random intercept, random slope model (M3) to investigate the moderating role of daily morning well-being (Research question 4). Finally, we included end-of-working well-being variables (L2) and general well-being variables (L3) in Model 4 to investigate the relationship between teachers' lesson-specific emotions and end-of-working well-being and general well-being (Research question 5). The hypothetical models of each step are shown in Figure 12.

Figure 12 *Hypothetical models for analysis (Manuscript 1)*



5.3. RESULTS

5.3.1. Descriptive statistics

On average, teachers have a more positive evaluation of their general well-being and end-of-working well-being. Teachers' positive emotions are above the midpoint of the scale (M = 3.62, SD = 0.62), while teachers reported a relatively low level of negative emotions (M = 1.86, SD = 0.69). Consistent with previous studies that mainly focused on enjoyment, anger, and anxiety (e.g., Frenzel et al., 2015, 2016, using a 4-point Likert scale), the negative emotions were low while the positive emotions were above the midpoint of the scale (e.g., the score of enjoyment in Frenzel et al. (2015) was 3.10 in the 4-point Likert scale). Intercorrelations of study variables on the lesson level are given in Table 7.

We then inspected intraclass correlations (ICC)[13] to assess the extent teacher emotions varied within lessons, between days, and between teachers. The ICC showed that a large proportion of variance of emotion lay at the teacher level: positive emotions were 0.59 (teacher), 0.09 (day), and 0.33 (lesson). Negative emotions were 0.56 (teacher), 0.09 (day), and 0.34 (lesson).

5.3.2. Lesson-specific student behaviour and teachers' lesson-specific emotions

Following model 1 (M1), we inspected fixed effects of teacher-perceived lesson-specific student disruptive behaviour and student engagement on teachers' positive and negative emotions. The effect of teacher-rated student disruptive behaviour on teachers' negative emotions was significant (β = 0.19, 95% credibility interval (C.I.) [0.02, 0.35]), showing that the more student disruptive behaviour the teachers perceived, the higher the negative emotions. Additionally, the effect of student engagement on teachers' negative emotions was significant negatively (β = −0.44, C.I. [−0.57, −0.31]), indicating that the more the students were involved in class, the fewer negative emotions teachers experienced.

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[13] ICC(teacher)=$s^2_{(t)}/s^2_{(t)}+s^2_{(d)}+s^2_{(l)}$, ICC(day)=$s^2_{(d)}/s^2_{(t)}+s^2_{(d)}+s^2_{(l)}$, ICC(lesson)=$s^2_{(l)}/s^2_{(t)}+s^2_{(d)}+s^2_{(l)}$, where t = teacher, d = day, and l = lesson

However, there was no significant effect of student disruptive behaviour on teachers' positive emotions (β = −0.00, C.I. [−0.16, 0.17]). Student engagement predicted teachers' positive emotions (β = 0.53, C.I. [0.41, 0.64]), showing that the more students engaged in the lesson, the more teachers experienced positive emotions.

5.3.3. Day and individual differences in the association between student disruptive behaviour and teachers' emotions

Following Model 2 (M2), we specified random terms (positive/negative emotions regressed on student disruptive behaviour in separate models) at the lesson level. We inspected the variance of the slope at the day level, and the mean and variance of the slope at the teacher level.

In terms of positive emotions, the average slope at the teacher level was B = −0.06 (C.I. [−0.28, 0.18]) with a variance of ψ = 0.05 (C.I. [0.00, 0.19]). The variance at the day level was ψ = 0.09 (C.I. [0.00, 0.22]). The steepness of the slope was not related to the day average positive emotions (ρ = 0.04, C.I. [−0.02, 0.10]) or teacher average positive emotions (ρ = −0.01, C.I. [−0.19, 0.19]).

For negative emotions, the average slope at the teacher level was B = 0.19 (C.I. [−0.16, 0.58]) with a variance of ψ = 0.27 (C.I. [0.00, 0.87]). The variance at the day level was ψ = 0.37 (C.I. [0.08, 0.78]). The steepness of the slope was related to the day

average negative emotions (ρ = 0.11, C.I. [0.01, 0.22]), but not to the teachers' average negative emotions (ρ = −0.13, C.I. [−0.50, 0.20]). This means that when the day average negative emotions are higher, the slope is steeper (i.e., disruptive behaviour predicts relatively more negative emotions for a particular teacher). Thus, the results show that the association between student disruptive behaviour and negative emotions varies across both days and teachers.

Overall, the results show that the association between student disruptive behaviour and negative emotions varies across both days and teachers. The association between student disruptive behaviour and positive emotions also varies across days or teachers.

5.3.4. Day and individual differences in the association between student engagement behaviour and teachers' emotions

Similarly, following Model 2 (M2), we then specified random terms (positive/negative emotions regressed on student engagement in separate models) at the lesson level, and inspected the variance of the slope at the day level, and the mean and variance of the slope at the teacher level.

For positive emotions, the average slope at the teacher level was B = 0.34 (C.I. [0.18, 0.51]) with a variance of ψ = 0.03 (C.I. [0.00, 0.11]). The variance at the day

level was $\psi = 0.06$ (C.I. [0.00, 0.17]). The steepness of the slope was not related to the day average positive emotions ($\rho = 0.01$, C.I. [−0.02, 0.05]), nor to teacher average positive emotions ($\rho = -0.03$, C.I. [−0.17, 0.08]). The results show there is a significant deviation of individual slope from the average slope across days and teachers.

In terms of negative emotions, the average slope at the teacher level was $B = -0.32$ (C.I. [−0.49, −0.13]) with a variance of $\psi = 0.03$ (C.I. [0.00, 0.13]). The variance at the day level was $\psi = 0.05$ (C.I. [0.00, 0.16]). These indicate a significant deviation of individual slope from the average slope across days and teachers. The steepness of the slope was not significantly related to the day average negative emotions ($\rho = -0.02$, C.I. [−0.07, 0.03]), nor the teacher average negative emotions ($\rho = -0.01$, C.I. [−0.17, 0.13]).

Overall, the results show that the association between student engagement and teacher emotions (positive and negative) varies across both days and teachers.

5.3.5. The moderating role of teachers' morning tiredness and the quality of sleep on the association between student behaviour and teachers' emotions

Following Model 3 (M3), we included day-level moderators (morning well-being: sleep quality and tiredness) of the association between student behaviour (student disruptive behaviour and student engagement) and teachers' emotions (positive and negative).

First, the positive/negative-emotions-on-student-disruptive-behaviour slopes were regressed on teachers' morning well-being, respectively. We found a moderation effect that teachers' morning quality of sleep predicted the slope (B = −0.43, C.I. [−0.74, −0.10]). In other words, the higher the morning quality of sleep, the less steep the slope. However, we do not find a moderation effect regarding the relationship between student disruptive behaviour and positive emotions (B = 0.15, C.I. [−0.10, 0.34]).

Next, the positive/negative-emotions-on-student-disruptive-behaviour slopes were regressed on teachers' tiredness in the morning. No moderation effect was found regarding positive emotions (B = −0.02, C.I. [−0.20, 0.17]) or negative emotions (B = 0.08, C.I. [−0.17, 0.33]).

When the positive/negative-emotions-on-student-engagement slopes were regressed on teachers' sleep quality in the morning, there is no other significant moderation effect of sleep quality on the positive-emotions-on-student-engagement slopes (B = −0.06, C.I. [−0.18, 0.13]) as well as the negative-emotions-on-student-engagement slopes (B = 0.04, C.I. [−0.12, 0.24]). Similarly, no other moderation effect was found of tiredness on the association between student engagement and teachers'

positive emotions (B = 0.05, C.I. [−0.06, 0.17]) or negative emotions (B = −0.08, C.I. [−0.13, 0.12]).

5.3.6. Teachers' lesson-specific emotions and teachers' end-of-working well-being and general well-being

Following Model 4 (M4), we then included fixed effects of teachers' end-of-working well-being and teacher-level general well-being (life satisfaction) into the model to examine whether teachers' positive and negative emotions further predict their well-being at the day level and teacher level. Results show that a higher level of teachers' daily average positive emotions significantly predicted more work enjoyment (β = 0.60, C.I. [0.15, 0.90]), and a higher level of work buoyancy (β = 0.76, C.I. [0.39, 0.97]), with a marginal effect of emotional exhaustion (β = −0.39, C.I. [−0.72, 0.01]) at the end of working but not work disengagement (β = −0.12, C.I. [−0.50, 0.36]). This means that a teacher who experiences a higher level of positive emotions on a particular day has a higher level of work-related well-being, especially in work enjoyment and buoyancy. In a similar vein, when teachers experience higher levels of positive emotions during the day, it is likely that they have lower levels of exhaustion at the end of that working day. At the teacher level, we also found that teachers' positive emotions were significantly predicted by teachers' general well-being (life satisfaction) before the research period (β

= 0.72, C.I. [0.14, 1.20]) and then predicted life satisfaction at the end of the research period (β = 0.58, C.I. [0.15, 0.88]). However, there was no significant relationship between teachers' positive emotions and teachers' harmony belief (β = 0.07, C.I. [−0.52, 0.63]) when controlling for life satisfaction (correlation (r) between harmony belief and positive emotion was 0.44, see Table 7).

Teachers' daily negative emotions only predicted teachers' end-of-working exhaustion (β = 0.60, C.I. [0.14, 0.95]) at the day level. Also, teachers' negative emotions had a significant relationship with teachers' life satisfaction (general well-being) at the beginning (β = −0.98, C.I. [−1.35, −0.59]) and predicted teachers' life satisfaction at the end (β = −0.55, C.I. [−0.86, −0.13]) of the research period. Thus, if teachers have higher levels of life satisfaction, they tend to have lower levels of negative academic emotions during the research period, and then have higher life satisfaction at the end of the research week.

5.4. DISCUSSION

This research extends the previous research on the role of teacher emotions in real-time during one calendar week. Particular attention was given to how teacher emotions were predicted by student behaviour in real-time classrooms, the variability across days and

teachers, and how teacher emotions further predict teachers' daily and individual level well-being.

5.4.1. Intraindividual variability

Inconsistent with previous studies on teacher emotions (Becker et al., 2015; Frenzel et al., 2015) who found that approximately 15%–30% of the variance in emotions (specifically enjoyment, anger, and anxiety) lies at the teacher level, we found that the majority of variance in teachers' positive and negative emotions between teachers (59% and 56%). However, we also found a considerable amount of variance in teachers' emotions due to different lessons (33%–34%). Therefore, teacher emotions are different between individual teachers and also fluctuate across different lessons. Interestingly, to some extent, the results of this study reflect the findings of de Ruiter et al. (2020), despite the fact that their definitions for levels in their research (within students, between students, and between teachers) differ from this study. They found that the majority of variance for anger was due to students (teacher reports of students, student level ICC = 0.21), and that the variance for self-related emotions (Teacher level ICC = 0.20) and anxiety (Teacher level ICC = 0.23) were mainly due to teacher characteristics. In the studies by Becker et al. (2015) and Frenzel et al. (2015), participants were mainly secondary school teachers in Germany and the data had a two-level structure (lessons

nested in teachers), while de Ruiter et al. (2020) used the day reconstruction focussing on teachers' perceptions toward specific students (students nested in teachers). Unlike previous studies, we grouped teacher emotions into positive and negative emotions and analysed teacher emotions based on a three-level structure (lesson, day, and teacher). It is worth noting that the participants in our study were primary school homeroom teachers in Taiwan and cultural differences do exist regarding emotion intensity and expression (Jack et al., 2012).

Based on the findings of previous cross-cultural research (Sims et al., 2015), one possible explanation is that Taiwanese teachers may have lower arousal and intensity of emotions and have less variability from one lesson to another. This may reflect the implicit "emotion rules" in the culture that teachers are expected not to express negative emotions or even "bring no emotion to the student" (Yin & Lee, 2012). Therefore, Taiwanese teachers may not express such fluctuated emotions as teachers in previous research across lessons.

5.4.2. Students' situation-specific behaviour and teachers' academic emotions

Results of this study showed that students' situation-specific behaviours, including disruptive behaviour and engagement, were significant predictors of teachers' emotions. When teachers perceived more student disruptive behaviour during teaching, they

tended to have higher levels of negative emotions in class. This result reflects the findings of previous studies that student disruptive behaviour predicts teachers' anger and anxiety (de Ruiter et al., 2020; Hagenauer et al., 2015). Previous research indicates that student disruptive behaviour is correlated to teachers' emotional exhaustion and work enthusiasm, and the link between student disruptive behaviour and emotional exhaustion exists even if the teacher-student relationship was taken into consideration (Aldrup et al., 2018). Regarding teachers' positive emotions, no significant relationship between student disruptive behaviour and teachers' positive emotions was found in the current study. This indicates that students' disruptive behaviour in real-time lessons does not derail teachers' positive emotions but is mainly related to teachers' negative emotions such as anger.

In line with previous cross-sectional research on student motivational behaviour and teacher emotions (Hagenauer et al., 2015), we found a significant effect of student engagement on teachers' positive emotions as well as negative emotions. Thus, when teachers feel that students engage in the lesson emotionally and behaviourally, they tend to experience more positive emotions and fewer negative emotions. Previous research only included teachers' anger, joy, and anxiety as teacher emotions, and the results indicated that joy and anger, but not anxiety were predicted by student engagement

(Hagenauer et al., 2015). Further research is needed on the potential discrepancies between different discrete emotions.

5.4.3. The variability of student behaviour and teachers' emotions and moderating effects

Our findings suggest that the effect of disruptive behaviour on teachers' positive emotions varied across days and individuals, and the effect of student disruptive behaviour on teachers' negative emotions also varied across both days and teachers. In addition, we found the effect of student engagement on teachers' positive and negative emotions varied across both days and individuals. That means, for some days, student behaviour (including student disruptive behaviour and engagement) has a large effect on teachers' positive and negative emotions, and for some teachers, student disruptive behaviour has a large effect on their negative emotions. Our findings regarding student behaviour and teachers' emotions reflect the fluctuation of the lesson and day-based nature of teacher emotions, as well as the differences between individual teachers.

Apart from the variability, we also found a moderating effect of teachers' self-rated sleep quality in the morning (morning well-being) on the relationship between student disruptive behaviour and their negative emotions. This indicates that teachers' morning well-being (sleep quality) has a positive effect on teachers' emotions in

reacting to students' disruptive behaviour. Teachers' sleep quality appears to help teachers manage their negative emotions when students misbehave in the classroom. Poor sleep quality could increase teachers' stress and irritability when they interact with students (Poon et al., 2019). This implies that teachers' recuperation at the beginning of a new day plays an important role in their interaction with students.

5.4.4. Teacher emotions predict teacher well-being

The findings of the current study show that teachers who have higher levels of positive emotions are more likely to have higher work enjoyment and work buoyancy at the end of the working day. However, teachers' negative emotions only predict teachers' emotional exhaustion at the end of the working day. In other words, the more intense the negative emotions teachers experience during the day, the more exhausted they feel. This is in line with the idea that positive emotions build up resources and help to increase an individual's well-being (Cohn et al., 2009; Fredrickson, 2003, 2013b). Teachers' positive emotions and negative emotions may work as two pathways. While negative emotions contribute to their judgement about how exhausted they are during work, positive emotions in lessons increase teachers' feelings of work-related well-being.

At the individual level, analyses showed that teachers' emotional experience in class (lesson-specific well-being) is reflected in teachers' overall level of life satisfaction (general well-being). The more positive emotions and fewer negative emotions teachers have in class, the more they are satisfied with their life as a whole. The present study shows the link between teachers' situational emotions and their daily work-related well-being as well as their general well-being.

5.4.5. Limitations and suggestions for future research

The findings of this study should be taken with the following limitations in mind. Firstly, the sample size at the teacher level was relatively small and the sample consisted of mostly females. Although the gender distribution in our research reflects the gender distribution in Taiwanese primary schools and our initial analyses showed no gender effects on teachers' general well-being, this may be due to the limited sample of male teachers. The second limitation is that in this study participants were recruited voluntarily. This could lead to bias if generally teachers who have high well-being with better classroom management experiences were more willing to participate in the research. Motivating a variety of teachers to participate in research with a larger sample size to validate findings would be beneficial in future research.

Third, we only used teachers' self-report data to analyse the relationship between student behaviour, teacher emotions, and teachers' well-being. Additionally, to lower the burden on participants, we only used a single item to assess the teachers' overall perceptions of their students' engagement in each lesson. Although the main aim of the current research is to understand teachers' momentary experiences regarding interaction with students and their well-being, it would be desirable to use multiple items for measurements and integrate other methods, such as external observations or student-report, to understand classroom conditions and teachers' response in class.

Moreover, despite the advantages of the Bayesian paradigm in mitigating the limitation of the Maximum Likelihood (ML) estimator and its robust estimation for small samples (Asparouhov & Muthén, 2020), it is not without limitations. One main limitation of a Bayesian paradigm is the potential subjectivity in selecting priors (Van De Schoot et al., 2014), thus it is crucial to specify priors based on informative prior knowledge. In this study, to mimic ML estimates, we specified diffuse priors (Heemskerk & Malmberg, 2020; Zitzmann et al., 2016), while it would be even more beneficial for future research to specify weakly informative priors (McNeish, 2019).

Finally, it is worth noting that the current research was conducted in a specific cultural context. Future studies are needed to understand teacher well-being from micro

perspectives in different cultural contexts. In this study, we included individuals' belief in interpersonal harmony conducted based on Chinese culture, which is recognised as a cultural specificity element that relates to personal well-being (Lu et al., 2001). Our results show that as a cultural backdrop, teachers' harmony belief is related to different aspects of teachers' appraisal of their experiences and well-being. It would be beneficial for future studies to take cultural specificity and the corresponding measurements into account.

5.4.6. Practical implications for practitioners

The ultimate goal of this study is to increase understanding of how teachers' real-time experience contributes to well-being. Such understanding will help teachers develop an awareness of their own emotional experiences when interacting with students, for example, the effect of student behaviour on teachers' emotions. In turn, this study could urge educators and policymakers to identify the potential ways to effectively support teachers in cultivating well-being.

An implication arising from this study echoes previous research on teacher enjoyment (e.g., Becker et al., 2015; Keller, Chang, et al., 2014). Teachers report emotional exhaustion but also feel that their work is rewarding at the end of their working day, and this is related to their emotions in the classroom. In line with the

theory (Fredrickson, 1998), the positive emotional experience could increase the personal resource with the existence of negative emotions. Thus, supporting teachers to be aware of their emotions and accumulate small positive emotions in the classroom could be beneficial to teachers' work-related well-being, and eventually increase their evaluation of life in general.

Another implication of the findings is that teachers' perceptions of student motivational (engagement) and discipline behaviour (disruptive behaviour) contribute to the variability of teacher emotions in the real-time classroom. Among them, a higher level of students' motivational behaviour relates to both higher positive emotions and lower negative emotions. This is especially true in primary schools, as primary homeroom teachers connect with the same group of students in a stronger way. Interventions that help teachers to develop effective classroom management strategies, such as elevate students' engagement while decreasing disruptive behaviour (e.g., behaviour-specific praise) in the classroom are needed (Gage & MacSuga-Gage, 2017; K. E. Larson et al., 2021).

Additionally, our findings also revealed that teachers' well-being is a cycle system that ties the teachers' situational experiences in school settings and their lives together (e.g., sleep quality, cultural context). There are approximately one-third of

Taiwanese primary school teachers feel stressed in their work and about one-fifth feel that their work has negative impacts on their physical or psychological health (Ko et al., 2019). Changing teachers' situational experiences in school settings could help these teachers. Thus, training projects that guide teachers to accumulate positive experiences and recuperate from work stress or exhaustion could spark off a positive loop in the classroom.

5.5. Conclusion

The present study was designed to integrate teachers' teaching and emotional experiences in class and their overall well-being, to point out how different layers of teacher well-being are connected with each other by utilising a micro-longitudinal approach. The results of this study are important in expanding the understanding of teachers' positive and negative academic emotions, and their empirical relationships with daily occupational well-being and their judgement of their life as a whole.

Teachers' perceptions of student behaviour, including both disruptive behaviour and engagement are important for their emotional experiences in class. Teachers experience more negative emotions in lessons with more student disruptive behaviour such as chatting and other off-task behaviours, or if students do not actively engage in the lesson. However, when teachers perceive that students are involved in class overall,

this not only increases their positive emotions but also decreases teachers' negative emotions. The results of the current study also suggest that teachers' academic emotions in class indeed predict their evaluation of their work-related well-being at the end of the working day, as well as how satisfied they are with their life as a whole.

This study provides a first step in studying teacher well-being from their momentary academic emotions to their life satisfaction as a process. This expands previous research on teacher well-being from a trait perspective and teachers' emotions from a state perspective. The findings of this study imply that teacher support programmes should focus on teachers' experiences and emotions when teaching. Studying the relationship between teacher-stated emotional experiences related to students, evaluation about work, and judgements about life helps to expand our knowledge about the dynamic of teaching and learning and different ways to support teachers.

CHAPTER 6. STUDY 2

Reciprocal relationships of teacher-student emotions in the classroom

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The contributions of each author (author statement, CRediT) to the manuscript are stated in Appendix H

ABSTRACT

The aim of this study was to investigate teacher-student emotional contagion and the reciprocal relationship between teachers' and students' emotions in real-time classrooms. Using the micro-longitudinal design, data on lesson-specific emotions were collected from twenty primary school teachers and their students (n_i=306). Teachers' self-reported emotions (n_{ti} =249), students' self-reported emotions, and student-perceived teachers' emotions (n_{ti} = 3891) were analysed using multilevel structural equation models (MSEM). The results indicated that students' perceptions of their teachers' emotions predicted their self-reported emotions. Additionally, the analysis of the reciprocal relationship showed the important role of teachers' emotions on students rather than students' emotions on teachers. The results implied that teachers and students might respond to different strategies to accumulate positive emotional experiences.

Keywords: Emotional contagion; Teacher emotions; Student emotions; Reciprocal relationship

6.1 INTRODUCTION

Emotions, a psychological state of human beings, are ubiquitous in everyday life and school settings (Trampe et al., 2015). Emotions are essential outcomes and contributors to teaching and learning (Pekrun et al., 2017) and are highly relevant to individuals' well-being (Fredrickson, 2001). In recent years, emotions in school settings have attracted researchers' attention because teachers' emotions in the classroom could be associated with student emotions and learning outcomes (Becker et al., 2014; Jennings & Greenberg, 2009). Classrooms are interaction centres, where the exchanges of one-on-one or between a teacher and a group of students create the reciprocal and dynamic nature of emotional contagion (Frenzel et al., 2018). Thus, a closer look at such emotional contagion is a key to understanding how to build a classroom with a positive climate and unpack the dynamics in the classroom.

As teachers' and students' emotions in the classroom are reciprocal, it is worth exploring how teachers' emotions predict students' emotions and how students' emotions predict teachers' emotions over time. However, empirical research on the emotional contagion between teachers and students is still scarce. Most studies on teacher-student contagion have focused on students' perspectives and unidirectional analysis (e.g., assumed teachers' effects on students only, but not the other way

around). Thus, issues such as the reciprocal relationships of emotions in real-time classrooms remain understudied in the existing research.

Therefore, the present study focused on lesson-specific emotional contagion between teachers and students based on both teacher and student reports. By doing so, we expanded previous studies in two ways: First, we investigated whether students' emotions were linked to student-reported teacher emotions and teacher-reported emotions in the concurrent real-time classroom. Second, we investigated the link between teachers' and students' prior and current emotions to explore the reciprocal relationships between and directionality of teacher and student emotions.

6.1.1 Emotions in academic settings

As a prevalent phenomenon, emotions are seen as relatively brief states with multiple components related to a particular personally meaningful situation (Fredrickson, 2001; Pekrun, 2006; Schutz et al., 2006). Emotions could be examined as discrete emotions or organised based on dimensions, such as valence (positive/negative) and activation (high activation/low activation). Within different categories of dimensions, positive and negative emotions are the most basic and common way of describing and communicating emotions (Watson & Tellegen, 1985).

In school settings, teachers and students likely experience various discrete emotions, also called academic emotions, related to learning and teaching activities, and the outcomes of learning or instructions, such as enjoyment, pride, anger, and anxiety (Pekrun et al., 2002). Compared to the numerous studies on student emotions in school settings, studies on teacher emotions are relatively scarce. It is plausible that teachers experience a series of emotions in the classroom, ranging from positive emotions, such as enjoyment and pride, to negative emotions, such as disappointment and anger (Hargreaves, 2000; Prosen et al., 2011). Teacher emotions, triggered in interaction situations, affect teachers' instructional behaviour and students' emotions (Becker et al., 2014, 2015; Frenzel, 2014; Hagenauer et al., 2015).

Previous research on student emotions in academic settings has pointed out common emotions in academic settings that are related to many academic situations. For example, enjoyment, pride, and relaxation are common positive emotions, while anger, anxiety, and boredom are common negative academic emotions (Pekrun et al., 2002). Evidence indicates that students' emotions in the academic setting are associated with important educational outcomes, such as students' self-regulated learning and academic achievement (Camacho-Morles et al., 2021; Pekrun et al., 2002, 2017). Positive emotions (e.g., enjoyment, pride) are associated with improved students'

performance, while negative emotions (e.g., anger, anxiety, boredom) are associated with decreased students' performance.

As Schutz (2014) noted, the optimal climate in the classroom would be that both teachers and students have positive and activated emotions; therefore, teachers' and students' emotions in academic settings are crucial issues to explore. Although discrete emotions are phenomenologically distinct, they share common functions based on their valence (positive and negative emotions). While negative emotions narrow individuals' focus, positive emotions could broaden students' and teachers' momentary thought-action repertoires and build their physical (e.g., new physical capability), intellectual (e.g., cognitive skills to find the right direction), and social (e.g., have a network to seek for emotional support) resource, among others, to help them to accomplish their goals or resolve problems (Fredrickson, 2001). That is, accumulating positive emotional experiences could help teachers and students widen their perspectives and build personal resources (e.g., enhance resilience) for future adversity. In this study, we grouped discrete emotions into positive and negative emotions when exploring teachers' and students' emotions in the classrooms. As previous research has pointed out that it is common for an individual to experience several emotions simultaneously

(Trampe et al., 2015), this could give us a more comprehensive idea of how complex emotions work in real-time classrooms.

It is worth noting that emotions might differ across academic settings. Compared to secondary school teachers and students whose emotions might be more strongly related to academic performance and outcomes, in primary schools, emotions might be related more to tasks, behaviour, and formative assessment in each lesson. Additionally, primary school classrooms are more intense, and homeroom teachers might be closer to their students because they spend more time together. Thus, teachers could be more emotionally positive and negative when reacting to their students in primary schools (Hargreaves, 2000).

6.1.2 Emotional contagion in the classroom

Emotional contagion, also called emotional transmission or emotional crossover, is a tendency of individuals to 'catch' or copy another person's emotions (Hatfield et al., 1993). People's emotions (e.g., sadness) can spread to others around them. It is a ubiquitous phenomenon between an individual and another individual, or between an individual and a group. Emotional contagion also occurs between teachers and students in educational settings (Frenzel et al., 2018; Frenzel, Goetz, Lüdtke, et al., 2009).

Evidence shows that student-perceived teachers' emotions could be associated with students' own emotions (e.g., enjoyment, anger, and anxiety). For instance, Chang and Cherng's (2017) cross-sectional research in secondary school demonstrated that when students' perceptions of teachers' positive emotions (e.g., hope, enjoyment) were higher, students tended to have a higher level of positive academic emotions. Similarly, when students reported that their teachers had a higher level of negative emotions (e.g., anger, anxiety, hopelessness), they experienced a higher level of negative emotions. The limited experience-sampling research on emotional contagion has also indicated that perceived teacher discrete emotions, such as anger, enjoyment, and anxiety, are related to students' discrete emotions, especially enjoyment (Becker et al., 2014; Keller & Becker, 2021). As such, when discussing emotional contagion from students' perspectives (students' reports of both teachers and students), teachers' positive and negative emotions could be transmitted to students in the classroom.

Yet, whether emotional contagion always occurs and whether social and contextual factors shape emotional contagion is inconclusive (Hatfield et al., 2014). The transmission of emotions between teachers and students may be even more complex in the real-time classroom. Teachers face a group of students in the classroom, but they simultaneously interact with different individual students behaviourally and emotionally

in each lesson. Commonly, teachers use strategies such as surface-acting (e.g., pretending to be happy or suppressing anger) to manage and regulate emotions and emotional expression to match the expectations of emotional expression in school settings (de Ruiter et al., 2021; Glomb & Tews, 2004; Keller & Becker, 2021). Previous studies reported mixed findings on emotional contagion between individuals and groups. Delvaux et al. (2016) investigated group pride and self-pride of university students and found that only group-relevant emotions (not self-pride) spread in groups, and group members' group pride converged toward the pride of members perceived as more influential. Emotional contagion could be selective and only elicited when the emotions are relevant to the individuals (Delvaux et al., 2016).

In a similar vein, although most studies on teacher-student emotional contagion have focused on students' reports of themselves and their perceptions of their teachers, the existing studies that included teacher-reported and student-reported emotions have demonstrated that the spread of emotions between teachers and students may follow a more indirect route. For example, Keller and Becker (2021) found that teachers' self-reported trait-like enjoyment was related to student enjoyment, but the relationship became insignificant after controlling for students' perceptions of teacher emotions and teacher emotional authenticity. Moreover, regarding negative emotions, such as anxiety,

the relationship between teachers' self-reported and students' anxiety was insignificant. For anger, teachers' self-reported anger was negatively correlated with student anger when considering other predictors (e.g., students' perceptions of teacher anger, and students' perceived teacher authenticity). An experience-sampling study on teachers' and students' boredom in the classroom also indicated no significant correlation between teachers' and students' self-reported boredom (Tam et al., 2019).

To date, most teacher-student emotional contagion studies have focused on specific discrete emotions, especially enjoyment, anger, and anxiety. However, teachers and students may experience multiple emotions in the classroom, and positive and negative emotions may work differently (Fredrickson, 2001). Positive emotional contagion might improve the group climate (Barsade, 2002). Furthermore, the transmission of positive emotions might be stronger than that of negative emotions (Keller, Chang, et al., 2014; Westman et al., 2013). Thus, it is important to decompose the emotional contagion of integrated positive emotions and negative emotions.

In summary, empirical findings on the trait or state emotions support the existence of the contagion of certain discrete emotions, such as enjoyment, anger, and anxiety, between teachers and students based on students' reports, while the link

between teacher-reported emotions and student emotions in the real-time classroom needs further research.

6.1.3 Reciprocal relationship between teachers' and students' emotions

Emotional contagion between teachers and students is usually viewed in one direction, assuming teachers' emotions may trigger their students' emotions, such as enjoyment or interest. To date, many empirical studies have focused on this unidirectional link. However, in converse, the directionality of emotional contagion could be reciprocal, as students can transmit emotions to their teachers (Frenzel et al., 2021).

The broaden-and-build theory indicates that positive emotions and negative emotions could have lingering after-effects and accumulate over time (Fredrickson, 2004). However, we know less about the dynamics of the emotional exchange between teachers and students over time. Teachers' and students' emotions could affect their subsequent emotions and experiencing positive emotions might help minimise the effect of negative emotions.

Some longitudinal studies have investigated the reciprocal association between the students' or teachers' emotional experiences and other variables, such as student-teacher relationship, academic performance, and teachers' instructional behaviour (Goetz et al., 2021; Pekrun et al., 2017). Despite the limited knowledge of the teacher-

student emotional relationship over time, the existing empirical evidence provides insight into how teachers' prior emotions could be connected to their own and students' emotions. For example, in a longitudinal study, Frenzel et al. (2018) found that students' enjoyment at the beginning of the school year (time 1) was associated with their enjoyment at the mid-term (time 3) at both within-class and between-class levels. However, average student enjoyment at the beginning of the school year predicted teachers' enjoyment at the mid-term via student-perceived teacher enthusiasm (time 2, indirect effect: $\beta = 0.09$, $p < .001$). Students' perceptions of teacher enthusiasm at time 2 partly mediated the effect of teachers' enjoyment at time 1 and the average student enjoyment at time 3. Thus, teachers' and students' emotions may predict their own later emotions or emotions of each other reciprocally.

6.1.4 An intraindividual approach: Micro-longitudinal design

Given that this study aimed to explore the change in momentary emotions and differences between students and teachers, it was important to use an intraindividual approach. An intraindividual approach allows researchers to study the variability of variables across situations within individuals over time (Voelkle et al., 2014).

To date, many studies on teacher-student emotions are based on the interindividual approach, focusing on the between-person variation. Although studies

on emotions in school settings using an intraindividual approach have grown in recent years (e.g., Becker et al., 2014, 2015; Goetz et al., 2015; Tam et al., 2019), more research is needed to explore the dynamic of emotional contagion in the classroom.

The present study applied a micro-longitudinal design to investigate the process of teacher-student emotions during primary school lessons. Going beyond the previous research, this study further incorporated teacher emotions, student-perceived teachers' emotions, and student emotions. We explored the emotional contagion of teachers and students from lesson to lesson, employing a micro-longitudinal design (lesson-specific) to reduce disruptions to the teaching and learning process while minimizing retrospective biases (Bolger & Laurenceau, 2013).

6.2 THE PRESENT STUDY

Previous studies have suggested a potential positive link between student perceptions of teachers' emotions and students' own emotions (e.g., enjoyment, anger, anxiety; see Becker et al., 2014; Chang & Cherng, 2017). Furthermore, teachers' and students' previous enjoyment at the beginning of the term could be linked to their enjoyment later at midterm (Frenzel et al., 2018). However, there is a lack of empirical evidence discussing the momentary emotional contagion between teacher-reported emotions, student-perceived teacher emotions, and students' emotions, particularly the reciprocal

relationships between teachers' and students' emotions in the classroom. Additionally, emotional contagion could be selective, which implies that teachers' emotional displays may not evoke congruent emotions in their students (Wrobel et al., 2021). Expanding previous research, this study collected teacher-reported, student-reported, and student-perceived teachers' emotions to investigate the relationships between teachers' and students' momentary emotions.

Emphasising the gaps in teacher-student emotional contagion, we proposed the conceptual framework (see Figure 13) and aimed to investigate the emotional contagion mechanism in two steps. First, we aimed to investigate emotional contagion between teachers and students in the real-time classroom by examining the relationship between teachers' emotions, student-reported teachers' emotions, and students' emotions. Second, we aimed to explore emotional transmission considering the reciprocal relationship between teachers' and students' emotions over time.

We proposed two overarching research questions and their sub-questions to guide our research as below:

1. **What is the relationship between students' emotions, student-perceived teacher emotions, and teachers' emotions?**

1.1 Do student-perceived teachers' emotions (positive/negative) predict students' emotions?

1.2 Do teachers' emotions predict students' emotions?

1.3 Do teachers' emotions predict student-perceived teachers' emotions?

2. Are there reciprocal effects of emotions between teachers and students?

2.1 What is the stability of students' emotions over time?

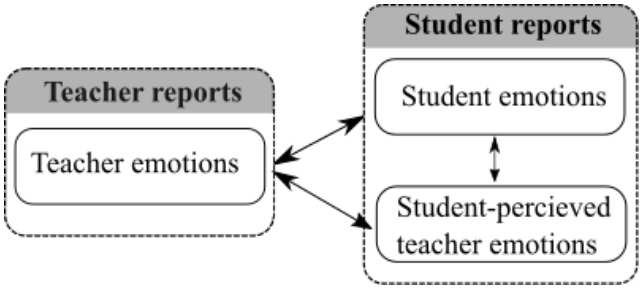
2.2 What is the stability of teachers' emotions over time?

2.3 Are there reciprocal effects between student-perceived teacher emotions and student emotions from lesson to lesson?

2.4 Are there reciprocal effects between teachers' and students' emotions from lesson to lesson?

2.5 Are there reciprocal effects between student-perceived teachers' emotions and teachers' emotions from lesson to lesson?

Figure 13 *Conceptual framework of teacher-student emotional transmission (Manuscript 2)*



6.3 METHOD

6.3.1 Participants

The present analysis was based on the data collected from teachers and their students in eight primary schools in two cities over a calendar week of one academic year in Taiwan. Participants in this study were 20 homeroom teachers (90% female) in public primary schools and their students (N = 306, two students out of 308 students who completed less than 50% of their lesson report were excluded from the current analysis). On average, teachers were 43.05 years old (SD = 9.01) with 16.13 years of teaching experience (ranging from 2-30 years). Half of the teacher participants had master's degrees, and another half of them had bachelor's degrees. Students (N = 306) were, on average, 10.40 years old (SD = 0.67), and 52.9% of them were boys (male = 162, female = 144). There were 130 (42.5%) Year 4 students and 176 (57.5%) Year 5 students. On average, students' performance was higher in Mandarin (M = 86.75, SD = 10.38) than in Mathematics (M = 81.50, SD = 14.84). As for students' family socioeconomic status, more than half of the students had middle to high or high family socioeconomic status (see Table 8).

6.3.2. Procedure

After receiving ethical approval from the university, the study started recruiting participants through schools. Teacher participants (homeroom teachers) were contacted after receiving the head teachers' permission. Only Year 4 or Year 5 homeroom teachers were invited. If teachers agreed to join the research, their students (and parents) were also invited to participate. Participation in this research was voluntary, and informed consent was obtained from all participants, including teachers, students, and parents.

Teachers and their students participated in the research for one calendar week. Teachers and students (and student parents) provided demographic information and reported their general well-being using a paper-and-pencil questionnaire at the beginning and the end of the study. At the end of each lesson, homeroom teachers[14] and their students were asked to fill out a short questionnaire using tablets (around 5 minutes before the end of each lesson). Teachers self-reported their emotional experiences, while students reported their teachers' lesson-specific and personal emotions.

[14] Homeroom teachers in the primary school in Taiwan teach the same group of students multiple subjects (e.g., Mandarin, Mathematics, Integrative Activities).

In total, 249 lesson reports from 20 teachers and 3891 lesson reports from 306 students were included in the analysis to produce the merged data and lagged variables[15]. Teachers' median answering time was 146 seconds, and students' median answering time was 82 seconds.

Table 8 *Characteristics of participants (Manuscript 2)*

		N	%	Mean (SD)	Range
Teachers (N = 20)					
Gender	Male	2	10.0		
	Female	18	90.0		
Age		20	100.0	43.05 (9.01)	28-55
Teaching experience		20	100.0	16.13 (8.56)	2-30
Students (N = 306)					
Gender	Boy	162	52.9		
	Girl	144	47.1		
Age		304	99.3	10.40 (0.67)	9.08-12.25
Family SES	High	106	34.6		
	Middle-high	80	26.1		
	Middle	103	33.7		
	Middle-low	12	3.9		
	Low	0	0		
Mathematics		305	99.7	81.50	17-100
Mandarin		305	99.7	86.75	43-100

6.3.3. Measures

In this study, we focused on teachers' and students' real-time emotional contagion in the classroom. Thus, we assessed teachers' and students' self-reported lesson-specific emotions and students' perceptions of teachers' emotions.

[15] Lagged variables were generated based on the lessons each day, for meaningful lagged variables, missing data-points (n=182) were inserted.

Teacher emotions. We used eight lesson-related items to assess teacher emotions in the classroom based on the framework of academic emotions (Pekrun, 2006; Pekrun et al., 2002). We included two activating emotions (e.g., enjoyment) and two deactivating emotions (e.g., calmness) in positive and negative dimensions. In this study, we used composite scores for positive and negative emotions to investigate the functions of broad dimensions of emotions while accommodating a wide range of discrete emotions in the classroom (Frenzel, 2014). Teachers were instructed to answer state-like emotions regarding how they felt during each lesson. Four items assessed participants' positive emotions during the lesson (e.g., "I felt relaxed") and four items measured participants' negative emotions (e.g., "I felt angry"). The information of reliability (Cronbach's α) and the McDonald's omega for teacher-reported positive emotions and negative emotions are reported in Li et al. (2022).

Student-perceived teacher emotions. Student-perceived teacher emotions were assessed by a parallel item wording of teacher emotions. Student participants responded on a 5-point Likert scale (1 = not at all, 5 = very much) to how their teachers felt, with 4 items assessing positive emotions (e.g., "my teacher was relaxed") and 4 items assessing negative emotions (e.g., "my teacher was angry"). Internal consistency was tested with Cronbach's α and the McDonald's omega coefficient. Cronbach's α of

positive emotions at two levels (time-points nested in students) and omega coefficients ranged from 0.56 to 0.87. For student-rated teachers' negative emotions, Cronbach's α and omega coefficients ranged from 0.72 to 0.93.

Student emotions. Consistent with the measurement of teacher emotions, students' emotions were measured by eight lesson-related items similar to those used for teacher emotions and student-perceived teacher emotions. Students' answers were assessed on a 5-point Likert scale, ranging from 1 (not at all) to 5 (very much). Four items examined students' positive emotions (e.g., "I felt relaxed"), and four gauged students' negative emotions (e.g., "I felt angry"). For student emotions, Cronbach's α and McDonald's omega coefficients for positive student emotions at two levels ranged from 0.61 to 0.78. For negative emotions, Cronbach's α and McDonald's omega coefficients were between 0.63 and 0.91.

Covariates. To control for the potential effects of teachers' and students' backgrounds, we included teachers' teaching experience and teachers' educational level at teacher-level. At student-level, we included students' gender, age, performance (average score in Mandarin and mathematics), and students' family socioeconomic status in the analysis. Teaching experience, student age, and student performance were continuous. Teachers' educational level was coded 0 for bachelor's and 1 for master's

degree. Students' gender was coded 0 for boys and 1 for girls. Students' family socioeconomic status was coded 1 for low, 2 for middle-low, 3 for middle, 4 for middle-high, and 5 for high.

6.3.4. Strategy of analysis

Given that our data were structured (see Figure 14) so that lesson-reports (Level 1: N= 3891) were nested within students (Level 2a: N= 306) and nested within teachers (Level 2b: N= 20), cross-classified models were specified and analysed using Mplus 8.4 (Muthén & Muthén, 1998-2017). All models were estimated using a multilevel structural equation modelling (MSEM) framework with Bayesian estimation, applying admissible-range-restricted priors (McNeish, 2019). Additionally, predictors were analysed using grand mean centring to achieve an interpretable intercept. We first examined cross-classified variance component models to estimate the variance in students' and teachers' positive and negative emotions, respectively.

Owing to our data format considering both teacher and student reports, linking teachers' and students' reports means teachers will share the same lesson with multiple students (a schematic dataset is shown in Table 9). Notably, the teacher reports were the same for each lesson for all the students, while the students' reports of the same lesson differed.

To answer our research question regarding the emotional contagion between homeroom teachers and students (including the sub-questions), we then tested a sequence of models in which lessons were nested within both students and teachers to identify the relationship between student-reported teachers' emotions, teachers' emotions, and students' emotions (Beretvas, 2011; Fielding & Goldstein, 2006).

Further, we conducted a sequence of lagged and cross-lagged models to investigate the reciprocal relationship between teachers' and students' emotions to answer all the sub-questions. We first tested teacher and student models to determine their prior emotions' effect on their current emotions, respectively. Then, we examined the reciprocal relationship between teachers' and students' emotions by testing models of teachers' and students' prior emotions on their current emotions.

Figure 14 *Cross-classified structure of the data (Manuscript 2)*

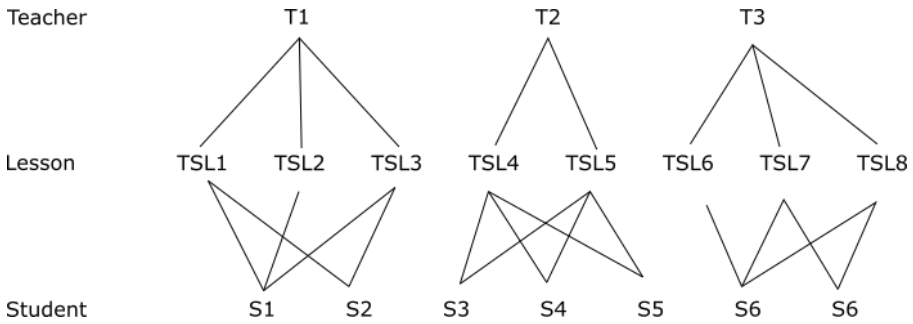


Table 9 *Schematic dataset structure (Manuscript 2)*

Teacher id	Student id	Lesson id	Teacher	Student	
			Pos Emo	Pos Emo	T's Pos Emo
1	101	1	4.25	3.75	4.25
1	102	1	4.25	4.25	3.75
1	103	1	4.25	2.75	3.25
1	104	1	3.50	4.25	3.75
1	102	2	3.50	3.50	3.75
1	103	2	3.50	3.75	3.25
1	104	2	3.50	3.25	3.50
…	….	…	…	…	…
2	201	1	4.00	4.25	4.00
2	202	1	4.00	4.50	4.25
….	….	…	…	…	…
20	2015	12	3.75	4.50	4.25

Note: The figure depicts the dataset structure of this study with virtual values. Teacher Pos Emo = teacher positive emotions, Student Pos Emo = student positive emotions, Student T's Pos Emo = student-perceived teacher positive emotions.

6.4 RESULTS

6.4.1 Descriptive statistics

Table 10 presents the descriptive statistics (i.e., mean scores, standard deviations, skewness, and kurtosis) and correlations between main variables at the lesson level. Overall, students' perceptions of their teachers' emotions and their self-reported emotions showed a similar pattern. Participants felt more positive emotions than negative emotions in the lessons. The means of students' perceptions of teachers' positive and negative emotions were 3.33 (*SD* = 0.94) and 1.73 (*SD* = 0.84), and students' positive and negative emotions were 3.40 (*SD* = 0.96) and 1.73 (*SD* = 0.83), respectively. The means of teachers' self-reported positive and negative emotions were 3.62 (*SD* = 0.62) and 1.78 (*SD* = 0.69), respectively.

Table 10 *Zero-order correlations and descriptive statistics of research variables (Manuscript 2)*

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
(1) SPE	1											
(2) SNE	0.23***	1										
(3) STPE	0.80***	-0.15***	1									
(4) STNE	0.16***	0.66***	-0.16***	1								
(5) TPE	0.14***	-0.08***	0.16***	-0.10***	1							
(6) TNE	0.08**	0.06**	-0.12***	0.09***	-0.61***	1						
(7) SPE(T-1)	0.65***	-0.11***	0.62***	-0.12***	0.07**	0.05*	1					
(8) SNE(T-1)	0.14***	0.59***	-0.11***	0.53***	-0.04	0.03	-0.23***	1				
(9) STPE(T-1)	0.62***	-0.09***	0.71***	-0.12***	0.10***	-0.10***	0.80***	-0.15***	1			
(10) STNE(T-1)	0.16***	0.54***	-0.16***	0.60***	-0.03	0.05***	-0.14***	0.66***	-0.16***	1		
(11) TPE(T-1)	0.16***	-0.08***	0.18***	-0.11***	0.65***	-0.50***	0.14***	-0.07***	0.19***	-0.10***	1	
(12) TNE(T-1)	0.05*	0.05*	-0.09***	0.07**	-0.47***	0.70***	-0.06**	0.04	-0.12***	0.06**	-0.66***	1
M	3.40	1.73	3.33	1.73	3.63	1.79	3.38	1.74	3.31	1.75	3.65	1.81
SD	0.96	0.83	0.94	0.84	0.62	0.69	0.95	0.82	0.94	0.84	0.62	0.70
Skewness	0.25	1.28	-0.11	1.20	-0.16	0.45	-0.24	1.28	-0.11	1.18	-0.11	0.42
Kurtosis	0.34	1.77	-0.30	1.35	0.23	-0.79	-0.29	1.88	-0.28	1.30	0.15	0.85
ICC1	0.42	0.52	0.36	0.49	0.37	0.37						
ICC2(S)	0.47	0.40	0.49	0.44	0.00	0.00						
ICC3(T)	0.10	0.07	0.15	0.07	0.62	0.63						

***p* < .05. ** *p* < .01. ***p* < .001**

Note. SPE = student positive emotions, SNE = student negative emotions, TPE = teacher positive emotions, TNE = teacher negative emotions, STPE = Student-perceived teacher positive emotions, STNE = Student-perceived teacher negative emotions. SPE(T-1)/SNE(T-1) = lagged student positive/negative emotions based on raw data. STPE(T-1)/STNE(T-1) = lagged student-percieved teachers' positive/negative emotions based on raw data. TPE(T-1)/TNE(T-1) = lagged teacher positive/negative emotions based on raw data.

The correlations between variables showed that students' positive and negative emotions were significantly related to all other variables. Specifically, students' positive emotions were significantly positively related to student-perceived teachers' positive emotions (r = .80) and students' positive emotions in the previous lesson (r = .65). In

contrast to students' positive emotions, students' negative emotions were significantly positively related to student-perceived teachers' negative emotions (r = .66) and students' negative emotions in the previous lesson (r = .59). Teachers' positive emotions, however, were mainly significantly positively related to their previous positive emotions (r = .65), while their negative emotions were especially significantly related to their previous negative emotions (r = .70).

6.4.2 Variability of teacher emotions and student emotions

The intraclass correlation coefficients (ICCs) at different levels were calculated based on cross-classified (time-points nested in both students and teachers) models (see Table 10). Regarding students' self-reported emotions, there was substantive variance across lessons (ICC = 0.42 for positive emotions and 0.52 for negative emotions) and students (ICC = 0.47 for positive emotions and 0.40 for negative emotions), with ICC around 0.10 at the teacher level. The ICCs of student emotions indicated that most of the variance in students' negative emotions came from situational variation between lessons, and most of the variance in students' positive emotions originated from the student level. A similar pattern was found for student-perceived teachers' emotions. For student-perceived teachers' positive emotions, the between-student variance was substantive (0.49 at the student level). In contrast, for student-perceived teachers'

negative emotions, between-lesson variance accounted for 0.49. The findings indicated that student-perceived teachers' positive emotions are primarily rooted in student-individual differences, but student-perceived teachers' negative emotions are relatively attributed to different situations (lessons).

Interestingly, for teacher emotions, despite a substantive variance in teachers' emotions across lessons, most of the variance in teachers' emotions originated from individual variation between teachers (ICC = 0.62 for positive emotions, and 0.63 for negative emotions).

6.4.3 Emotional contagion in the classroom

Student-perceived teachers' emotions and students' emotions

To understand the phenomenon of emotional contagion in the classroom and answer the research questions, we first conducted a sequence of models that investigated the relationship between student-perceived teachers' emotions and students' emotions at the same time points, while controlling for the background variables at the student level (i.e., gender, age, student performance, and family SES) and the teacher level (i.e., teaching experience and educational level).

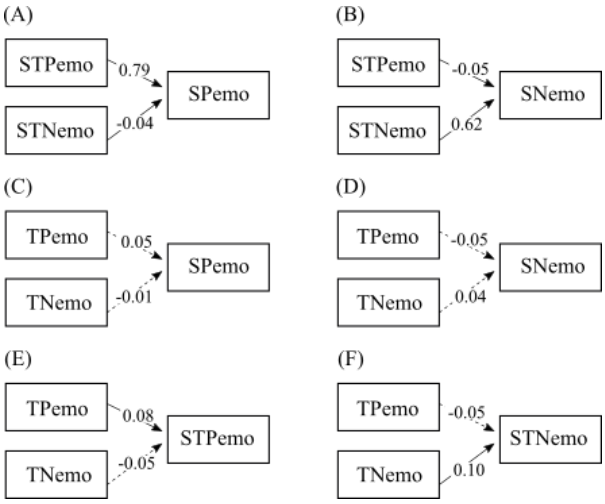
As shown in Figure 15, the analysis indicated that students' perceptions of teachers' emotions predicted students' emotions at the lesson level. Higher student

positive emotions were predicted by student-perceived higher teachers' positive emotions (β = 0.79, 95% C.I. [0.77, 0.80]) and lower negative emotions (β = -0.04, C.I. [-0.07, -0.02]). Similarly, a higher level of student negative emotions was predicted by a higher level of student-perceived teachers' negative emotions (β = 0.62, C.I. [0.60, 0.64]) and a lower level of positive emotions (β = -0.05, C.I. [-0.09, -0.02]).

The results of covariates showed that only students' performance predicted students' negative emotions at the student level (β = -0.17, C.I. [-0.31, -0.02]). Higher students' performance was linked to lower students' negative emotions. No other effect of covariates (student background and teacher background variables) on student emotions at the teacher level was found.

In summary, our results are consistent with previous research on emotional contagion between student-perceived teachers' emotions and students' emotions (Becker et al., 2014). Higher student-perceived teachers' positive emotions were associated with students' higher positive and lower negative emotions during the lesson. Moreover, higher student-perceived teachers' negative emotions were associated with higher students' negative and lower positive emotions.

Figure 15 *Relationships between perceived teacher emotions, teacher emotions, and student emotions (Manuscript 2)*



Note. Estimates in the figure are standardised estimation with the 95% corresponding credible interval (C.I.). $SPemo_T$/$SNemo_T$ = student positive/negative emotions, $TPemo_T$/$TNemo_T$ = Teacher positive/negative emotions, STPemo/ STNemo = Student-perceived teacher positive emotions/negative emotions.

Teachers' emotions and students' emotions

After examining the relationship between student-perceived teachers' emotions and student emotions, we investigated the relationship between teachers' and students' own situational emotions to expand previous research and understand the direct link between teachers' and students' emotions in the classroom.

Our second set of models showed that compared to the first set of models, teachers' emotions did not predict students' emotions (see Figures 15-C and 15-D). Teachers' positive emotions only marginally predicted students' positive emotions (β = 0.05, C.I. [0.00, 0.10]). The covariate effect of students' academic performance

predicted students' positive (β = 0.17, C.I. [0.03, 0.30]) and negative (β = -0.20, C.I. [-0.33, -0.06]) emotions at the student level. Students with higher academic performance tend to have higher positive and lower negative emotions. No other covariate effects at the student level (2-a) and the teacher level (2-b) were found. These findings indicated that when examining teacher-reported and student-reported emotions simultaneously in the classroom, there were no clear direct effects of teacher-reported emotions on student-reported emotions.

Teachers' emotions and student-perceived teachers' emotions

To understand whether teachers' self-reported emotions predict students' perceptions of teachers' emotions, we conducted models to examine this relationship. Controlling for the covariate variables at the student level and teacher level, the results (see E and F in Figure 15) indicated that teachers' positive emotions predicted students' perceptions of their teachers' positive emotions (β = 0.08, C.I. [0.03, 0.13]), whereas teachers' negative emotions did not (β = -0.05, C.I. [-0.10, 0.00]). Higher positive emotions of teachers in the lesson were associated with student-reported teachers' positive emotions. Similarly, teacher-reported higher negative emotions positively predicted student-perceived teachers' negative emotions (β = 0.10, C.I. [0.05, 0.15]). That is,

students reported teachers had a higher level of negative emotions, consistent with their teachers' reports of negative emotions in the lesson.

6.4.4 Reciprocal relationships between teachers' emotions and students' emotions

To understand the reciprocal relationship between teacher emotions and student emotions, we conducted a sequence of cross-lagged models. We first investigated the lagged effect of students' emotions and teachers' emotions, respectively, to examine the stability of teachers' emotions and students' emotions across lessons. Subsequently, we examined the reciprocal relationship between student-perceived teachers' emotions, students' emotions, and teachers' emotions.

Students' and teachers' emotional stability

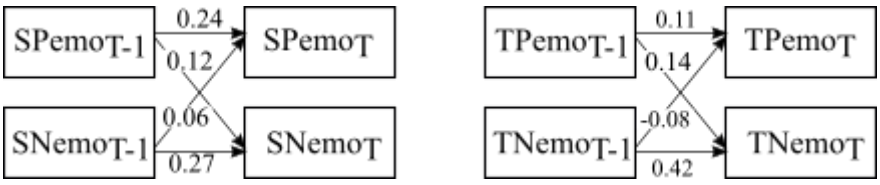
Firstly, we conducted two models to investigate whether students' and teachers' emotions in the previous lesson can separately predict their later emotions (see Figure 16). The results of the student model showed the autoregressive paths from students' prior positive emotions (T-1) to their subsequent (T) emotions (positive: $\beta = 0.24$, C.I. [0.19, 0.29]; negative: $\beta = 0.27$, C.I. [0.22, 0.31]). In addition, students' prior negative emotions (T-1) predicted their subsequent (T) positive emotions ($\beta = 0.06$, C.I. [0.01, 0.11]). Similarly, students' prior positive emotions predicted their subsequent negative emotions at the lesson level ($\beta = 0.12$, C.I. [0.07, 0.17]).

In the teacher models, again, autoregressive paths showed that teachers' prior emotions (T-1) predicted their current emotions (positive: β = 0.11, C.I. [0.04, 0.18]; negative: β = 0.42, C.I. [0.36, 0.48]). In addition, teachers' prior positive emotions positively predicted their subsequent negative emotions (β = 0.14, C.I. [0.07, 0.21]), and teachers' prior negative emotions negatively predicted teachers' subsequent positive emotions (β = -0.08, C.I. [-0.14, -0.01]). In this model, teachers' prior negative emotions were negatively associated with teachers' prior positive emotions (ρ = -0.66, C.I. [-0.68, -0.63]), and teachers' subsequent positive emotions were negatively correlated with their subsequent negative emotions (ρ = -0.36, C.I. [-0.39, -0.33]). Interestingly, compared to the effect of prior teachers' positive emotions on teachers' subsequent positive emotions (path 1), the effect of prior teachers' negative emotions on teachers' subsequent negative emotions (path 2) was stronger (path1-path2 = -0.19, C.I. [-0.26, -0.12]).

In summary, the models showed the stability of students' and teachers' emotions from lesson to lesson. On average, a higher level of students' positive emotions in the previous lesson predicted higher subsequent positive emotions, and a higher level of students' negative emotions in the previous lesson predicted higher subsequent negative

emotions. A similar pattern was found in the teacher model, indicating that students' and teachers' emotions linger to some extent (Hamaker, 2012; Kuppens et al., 2010).

Figure 16 *Student and teacher emotion stability (Manuscript 2)*



Note. Estimates in the figure are standardised estimation with the 95% corresponding credible interval (C.I.). $SPemo_T$/$SNemo_T$ = Student positive/negative emotions, $TPemo_T$/$TNemo_T$ = Teacher positive/negative emotions, $SPemo_{T-1}$/ $SNemo_{T-1}$ = lagged student positive emotions/negative emotions, $TPemo_{T-1}$/ $TNemo_{T-1}$ = lagged teacher positive emotions/negative emotions.

6.4.5 Reciprocal relationships between student-perceived teachers' emotions and students' emotions

Figure 17 presents the reciprocal relationships between students' emotions and their perceptions of teachers' emotions at the lesson level, controlling for the covariates at the student level and teacher level. The results (Figure 17-A, B) showed that students' self-rated current positive emotions (T) were predicted by student-perceived teachers' prior emotions (T-1, positive: β = 0.39, C.I. [0.33, 0.44]) and students' prior positive emotions (β = 0.26, C.I. [0.21, 0.32]). Similarly, current student-perceived teachers' positive emotions were also predicted by students' prior positive emotions (β = 0.13,

C.I. [0.08, 0.18]) and student-perceived teachers' prior positive emotions (β = 0.60, C.I. [0.56, 0.64]).

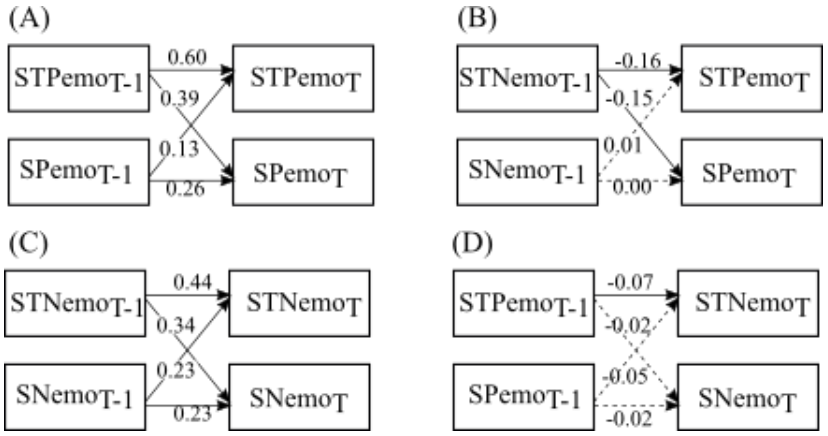
Additionally, prior student-perceived teachers' negative emotions but not students' own prior negative emotions predicted current student positive emotions (β = -0.15, C.I. [-0.20, -0.09]) and student-perceived teachers' positive emotions (β = -0.16, C.I. [-0.21, -0.11]). Higher student-perceived teachers' negative emotions in the previous lesson were associated with lower student-perceived teachers' positive emotions and students' positive emotions in the subsequent lesson.

Regarding negative emotions in the classroom (see C and D in Figure 17), current student-perceived teachers' negative emotions were predicted by students' (β = 0.23, C.I. [0.18, 0.28]) and student-perceived teachers' (β = 0.44, C.I. [0.40, 0.48]) prior negative emotions, as well as their perceptions of teachers' positive emotions in the previous lesson (β = -0.07, C.I. [-0.14, -0.01]). Correspondingly, students' current negative emotions were predicted by both prior student negative emotions (β = 0.23, C.I. [0.19, 0.27]) and student-perceived prior teachers' negative emotions (β = 0.34, C.I. [0.30, 0.39]).

In summary, when students had a higher level of positive emotions and perceived their teachers to have higher positive emotions in the previous lesson, they

were more likely to have higher positive emotions and reported higher teachers' positive emotions. Students' prior negative emotions had no clear effect on their and their perceptions of teachers' subsequent positive emotions. In addition, only previous students' perceptions of teachers' positive emotions predicted subsequent lower student-perceived teachers' negative emotions. However, when students' and student-perceived teachers' negative emotions in the previous lesson were high, their negative emotions in the subsequent lesson tended to be high.

Figure 17 *Reciprocal relationships between student-perceived teachers' emotions and students' emotions (Manuscript 2)*



Note. Estimates in the figure are standardised estimations with the corresponding credible interval (C.I.). The dotted lines represent that a zero is included in the credible interval. $SPemo_T$/$SNemo_T$ = Student positive/negative emotions, $STPemo_T$/$STNemo_T$ = Student-perceived teacher positive/negative emotions, $SPemo_{T-1}$/ $SNemo_{T-1}$ = Lagged student positive emotions/negative emotions, $STPemo_{T-1}$/ $STNemo_{T-1}$ = Lagged student-perceived teacher positive emotions/negative emotions

6.4.6 Reciprocal relationships between teachers' emotions and students' emotions

To verify whether the emotional transmission of teachers' and students' emotions is reciprocal, we further examined the relationship between teachers' and students' previous emotions and subsequent emotions while controlling for the effect of covariates (see Figure 18).

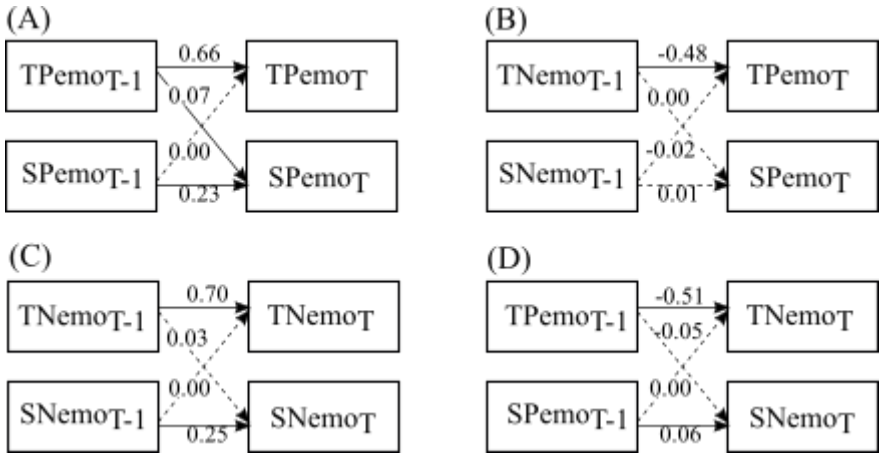
For positive emotions, our findings demonstrated that students' current positive emotions were mainly positively predicted by students' prior positive emotions (β = 0.23, C.I. [0.18, 0.28]) and teachers' prior positive emotions (β = 0.07, C.I. [0.01, 0.12]. However, teachers' current positive emotions were only predicted by teachers' prior positive emotions (β = 0.66, C.I. [0.64, 0.68]) but not students' prior positive emotions (β = 0.00, C.I. [-0.03, 0.04]). Interestingly, although no clear effect of prior teachers' (β = 0.00, C.I. [-0.05, 0.06]) and students' negative emotions (β = 0.01, C.I. [-0.04, 0.06]) on students' subsequent positive emotions was found, prior teachers' negative emotions negatively predicted teachers' subsequent positive emotions (β = -0.48, C.I. [-0.51, -0.44]). In other words, higher teachers' negative emotions in the previous lesson were associated with lower subsequent teachers' positive emotions.

In terms of negative emotions in the real-time classroom, prior teachers' negative emotions predicted subsequent teachers' negative emotions (β = 0.70, C.I.

[0.67, 0.72]) but not students' negative emotions (β = 0.03, C.I. [-0.02, 0.08]). However, students' prior negative emotions mainly predicted students' subsequent negative emotions (β = 0.25, C.I. [0.20, 0.30]). Additionally, teachers' negative emotions were negatively predicted by teachers' prior positive emotions (β = -0.51, C.I. [-0.54, -47]). However, students' subsequent negative emotions were positively predicted by students' prior positive emotions (β = 0.06, C.I. [0.01, 0.11]) and marginally predicted by teachers' prior positive emotions (β = -0.05, C.I. [-0.11, 0.00]).

To summarise, a higher level of teachers' positive emotions in the previous lesson was associated with a higher level of teachers' and students' positive emotions and lower teachers' negative emotions in the current lesson. When teachers reported higher levels of negative emotions in the previous lesson, they reported higher subsequent negative emotions and lower subsequent positive emotions. When students reported higher levels of prior positive emotions, they reported higher subsequent positive emotions and negative emotions. If students reported higher levels of negative emotions in the previous lesson, they reported higher levels of subsequent negative emotions.

Figure 18 *Reciprocal relationships between teachers' emotions and students' emotions (Manuscript 2)*



Note. Estimates in the figure are standardised estimations with the corresponding credible interval (C.I.). The dotted lines represent that a zero is included in the credible interval. $SPemo_T$/$SNemo_T$ = Student positive/negative emotions, $TPemo_T$/$STNemo_T$ = Teacher positive/negative emotions, SPE_{T-1}/ SNE_{T-1} = Lagged student positive emotions/negative emotions, $TPemo_{T-1}$/ $TNemo_{T-1}$ = Lagged teacher positive emotions/negative emotions.

6.4.7 Reciprocal relationships between student-perceived teachers' emotions and teachers' emotions

Figure 19 presents the results of the reciprocal relationship between student-perceived teachers' emotions and teachers' own emotions at the lesson level, controlling for the covariates. Our findings demonstrated that student-perceived teachers' current positive emotions (T) were predicted by students' prior perceptions of teachers' positive emotions (β = 0.27, C.I. [0.22, 0.32]), teachers' self-reported prior positive emotions (β = 0.11, C.I. [0.05, 0.16]), and teachers' prior negative emotions (β = -0.06, C.I. [-0.11, -0.01]). However, teachers' current positive emotions were

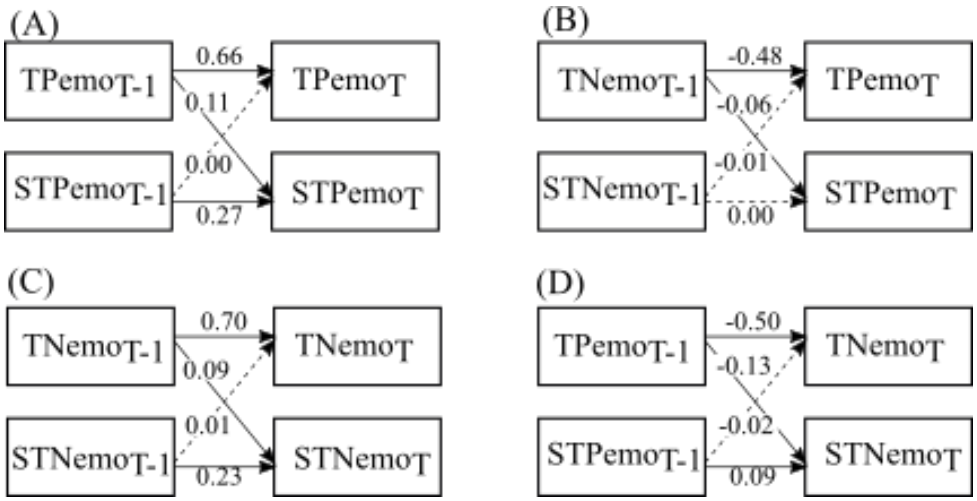
predicted by their prior positive emotions (β = 0.66, C.I. [0.64, 0.69]) and negative emotions (β = -0.48, C.I. [-0.51, -0.44]).

Current student-perceived teachers' negative emotions, on the other hand, were positively predicted by both teachers' prior negative emotions (β = 0.09, C.I. [0.04, 0.14]) and student-perceived teachers' prior negative emotions (β = 0.23, C.I. [0.19, 0.28]). They were also predicted by teachers' prior positive emotions (β = -0.13, C.I. [-0.18, -0.08]). If teachers had a higher level of positive emotions in the previous lesson, students believed teachers showed fewer negative emotions in the subsequent lesson. Our results indicated that teachers' current negative emotions were only predicted by their own prior positive emotions (β = -0.50, C.I. [-0.53, -0.47]) and negative emotions (β = 0.70, C.I. [0.67, 0.72]).

In summary, the results indicated that when teachers had a higher level of positive emotions in the previous lesson, they reported higher positive and lower negative emotions in the current lesson. Likewise, students also reported higher levels of teachers' positive emotions and lower levels of teachers' negative emotions in the current lesson. In contrast, when students perceived teachers to have higher positive emotions in the previous lesson, they were more likely to report their teachers having higher positive emotions in subsequent lessons. A similar pattern was found for the

effect of prior teachers' negative emotions on both students' perceptions and teacher-reported negative and positive emotions. Teachers and students reported that teachers had lower levels of positive and higher levels of negative emotions in the subsequent lesson after teachers reported a higher level of prior negative emotions. However, greater students' perceptions of teachers' negative emotions in the previous lesson only affected students' perceptions of teachers' negative emotions in the subsequent lesson.

Figure 19 *Reciprocal relationships between teachers' and student-perceived teacher emotions (Manuscript 2)*



Note. Values in the table are standardised estimations with the corresponding credible interval (C.I.). STPemo/STNemo = Student-perceived teacher positive/negative emotions, TPemo/TNemo = Teacher positive/negative emotions, $STPemo_{T-1}$/$STNemo_{T-1}$ = Lagged student-perceived teacher positive/negative emotions $TPemo_{T-1}$/$TNemo_{T-1}$ = Lagged teacher positive/negative emotions.

6.5 DISCUSSION

To the best of our knowledge, this study was the first one to explore the reciprocal relationship between teachers' and students' lesson-specific emotions based on

teachers' emotions, student-reported teachers' emotions, and students' emotions. Our findings thus articulate the relationship between current emotions and emotions in the previous lesson considering both teachers and students.

6.5.1 Variability in teachers' and students' emotions

Our analysis showed that the greatest variability in students' emotions, especially negative ones, was between lessons. For students' positive emotions, however, most variation was attributable to both the lesson level and student level. Similar results emerged for student-perceived teachers' emotions. This is partly in line with the findings of previous experience sampling (e.g., Goetz et al., 2013) and cross-classified research (e.g., Mainhard et al., 2018), indicating that strong variation situates at the lesson level, reflecting a real-time assessment from students' reports.

It is worth noting that most previous intraindividual research on discrete emotions (e.g., enjoyment, anger, anxiety) has focused on 2-level models about student reports and discovered that around 70% to 80% of secondary school students' emotions were attributable to between situation variations (e.g., Becker et al., 2014; Keller & Becker, 2021). Similar results have been found for student-perceived teacher emotions. For example, the findings of Keller and Becker (2021) indicated that approximately 77% - 81% of the variance in students' perception of teacher enjoyment, anger, and

anxiety was attributable to the between-lesson level. On the other hand, our findings point out the different patterns of positive and negative emotions among primary school students in Taiwan. Primary school students in this study tended to attribute teachers' negative emotions to situations but viewed teachers' positive emotions as more stable across lessons. In contrast, the variability in negative emotions from one lesson to another was greater than the variability in positive ones, reflecting a more lesson-specific pattern.

Interestingly, from teacher reports, the most variability in teachers' positive and negative emotions originated from the between-teacher level. Accordingly, this may reflect the idea that emotions could be understood as a state-trait continuum (Frenzel et al., 2021). Although momentary emotions work mainly at the lesson level, they may reflect individuals' connection with their socially constructed beliefs and reactions to different situations (Schutz et al., 2006, p.344). Moreover, teachers are more likely to apply emotional self-regulation skills in the classroom to keep the classroom organised. For example, teachers may try to keep their distance from their emotions or suppress them to maintain stability. This could explain the relatively stable trend in teachers' emotions and differences between individual teachers in this study.

6.5.2 Emotional contagion between teachers and students

Consistent with previous research on discrete emotions, we found a significant relationship between student-reported teachers' and students' emotions (e.g., Becker et al., 2014). Students reported having a higher level of positive and lower level of negative emotions that was consistent with their reports of teachers' positive emotions. On the contrary, students experienced as having a higher level of negative emotions and a lower level of positive emotions when they perceived teachers having a higher level of negative emotions and lower levels of positive emotions.

Furthermore, we also found that teacher-reported emotions predicted students' perceptions of teachers' emotions, indicating that student-perceived teachers' emotions can reflect teachers' evaluation of their emotions to some extent. However, our findings indicated no clear relationship between teachers' and students' emotions in the subsequent lesson, expanding the findings of a previous study in which students did not accurately perceive teachers' boredom (Tam et al., 2019). This may be because students, especially primary school students, rely on relatively explicit cues from teachers' emotional displays (e.g., gestures and facial expressions). Another possibility is that teachers' emotional regulations in class, such as surface acting (pretending to have another type of emotion), may increase the gap between students' perceptions of

teachers' emotions and teachers' self-reported emotions due to the lack of emotional authenticity (Keller & Becker, 2021). For instance, when teachers feel angry in the classroom, they may mask their anger and pretend they are happy. Additionally, this could be related to the fact that teachers may regulate their emotions based on the implicit emotional display rules in class to perform the anticipated emotions (Burić & Frenzel, 2021; Zembylas, 2004).

6.5.3 Reciprocal relationships between teachers' emotions and students' emotions

First, our findings of reciprocal models showed that teachers' emotions in the previous lesson predicted their subsequent emotions, and students' emotions in the previous lesson predicted students' subsequent emotions. Our findings thus support the spillover or after-effects of emotions or the emotional contagion over time according to the broaden-and-build theory (Fredrickson, 2001, 2004), implying that emotions in the previous time point linger.

Next, like the results of concurrent emotional contagion, we found that student-perceived teachers' emotions in the previous lesson predicted students' emotions in the subsequent lesson. Furthermore, students' emotions in the previous lesson also predicted student-perceived teachers' emotions in the subsequent lesson. Our findings thus suggest the reciprocal relationship between student-perceived teachers' emotions

and students' emotions. This implies that students' emotions and their perceptions of teachers' emotions interact with each other over time.

Additionally, we found that students' current positive emotions were predicted by teachers' prior positive emotions, while teachers' current emotions were mainly predicted by their own prior emotions. These findings further expand our results of the first research question, which concerns only the emotional contagion of teachers and students in the concurrent lesson. Our analysis of reciprocal relationships revealed a delayed but direct positive emotional contagion from teacher to students but not the other way around. One possibility is that a teacher interacts with a group of students with various emotions, which minimises student emotions' effect on teachers' emotions. Moreover, compared to all students, some students in class might have a greater effect on teachers' emotions. Thus, no clear effects were found of student emotions on teacher emotions. Another possibility is that teachers may have self-regulated their emotions that are impacted by students. It is also worth noting that we did not investigate teachers' perceptions of student emotions in the current study; thus, we did not examine whether teachers' perceptions of general students' emotions predict teachers' emotions.

6.6 LIMITATIONS

Based on previous studies, this study aimed to expand the knowledge of teacher-student emotional contagion in the real-time classroom. By integrating teachers' and students' self-reports and students' perceptions of teachers' real-time emotions, this study allowed us to examine emotional contagion from multiple aspects, minimising the bias coming from self-reported data. However, it is important to acknowledge several limitations.

One limitation of this study concerns the sample of participants. Participation in this study was voluntary, suggesting that this could lead to a bias that certain types of participants were more willing to join the research. For example, teachers who were more motivated or confident about their teaching may be more likely to participate. Moreover, the sample size of teacher participants was relatively small. Although the emotional contagion was analysed based on multiple time points (lessons), and the number of teachers (N = 20) should have been sufficient to yield robust results, it would be beneficial for future research to validate the findings with a larger sample size of teachers.

Secondly, although this study included both student reports and teacher reports to minimise the self-report bias and conducted an in-depth investigation of the contagion mechanism between teachers and students, it should be noted that this study,

still, is based on self-reported data. Integrating other measures (e.g., observations) would benefit future research.

Furthermore, we did not include teachers' perceptions of student emotions in this study. Thus, we could not conduct a parallel analysis to investigate whether teachers' perceptions of student emotions correspond with students' emotions. As we found that students cannot always precisely identify teachers' emotions in the classroom, it would be interesting to explore whether this is the case for teachers. Additionally, we grouped teachers' and students' discrete emotions when teaching and learning into positive and negative emotions to investigate the emotional contagion in school settings. It is worth noting that the relationship between teachers' specific discrete emotions (e.g., anxiety, anger, enjoyment, pride) and students' discrete emotions could be discussed independently to extend our understanding of learning and teaching emotions in school settings.

Finally, this study did not investigate what specific events teachers or students experienced in the lesson that might have elicited their positive and negative emotions or even a certain type of emotion (e.g., teachers' anger because a student chatted loudly in class). It would be favourable to link the specific reason or antecedent of teachers'

and students' emotions in the lesson. Future studies could consider this association to deepen the understanding of the emotional contagion mechanism.

6.7 IMPLICATIONS AND CONCLUSIONS

The present study investigated the emotional contagion considering the reciprocal relationship between primary school teachers and their students in real-time classrooms. By incorporating teacher-reported emotions, student-perceived teachers' emotions, and students' self-reported emotions, we expanded previous studies and contributed to the theory.

From the theoretical viewpoint, our study supports that students' perceptions of teachers' positive emotions can be considered a source that elicits students' positive emotions to build up a positive classroom. This also implies that students' awareness of their teachers' emotions matters to their own emotions. In addition, aligned with emotional contagion theory (Hatfield et al., 1994), the findings of the reciprocal relationships between teachers' and students' emotions support that teachers could transmit their emotions (as a sender rather than a receiver in the contagion process) because of higher control or powers in the classroom. Thus, emotions are more likely transmitted from teachers to their students in the classroom.

One practical implication of the present study is related to the intriguing findings that students' current positive emotions can be predicted by students' emotions and their perceptions of teacher emotions in the previous lesson, as well as teacher-reported positive emotions in the previous lesson. Thus, interventions that focus on improving classroom emotional experiences need to address both teachers and students simultaneously. On the one hand, interventions could be designed to improve teachers' emotional experiences over time in the classroom, increasing a positive climate in the class. On the other hand, it seems that students' perceptions of teachers' emotions play an important role. Thus, interventions could aim to train students to be aware of their emotions and others' emotions.

In the classroom setting, it is common for teachers to display their emotions following certain implicit rules in certain cultural contexts. Interestingly, Taiwanese culture, which addresses interpersonal harmony, could encourage emotional suppression to find the appropriate response and to preserve relationships (Matsumoto et al., 2008; Yeh et al., 2017). Although it may have a prosocial function, it could decrease the emotional authenticity of teachers' emotions (Keller & Becker, 2021). An encouraging finding of this study is the significant relationship between teachers' prior positive emotions and students' subsequent positive emotions. An implication is that

sharing emotional experiences rather than suppressing negative emotions or pretending to have positive emotions might be more beneficial to teachers and students. By sharing emotional experiences collectively, teachers and students express and explain the reasons for their emotions, improving their understanding of each other and their positive emotions.

In conclusion, the findings of our study support the emotional contagion between student-perceived teachers' emotions and students' emotions. Further, the reciprocal relationship between teachers' emotions and students' emotions indicated that teachers' emotions are mainly based on their own prior emotions, while students' emotions were predicted by perceived teachers' prior emotions and students' prior emotions. The study provides a clearer picture of teacher-student emotional contagion, the lagged effect of emotions in the classroom, and the important role of teachers' emotions in reciprocal relationships between teachers' and students' emotions.

CHAPTER 7. STUDY 3

Exploring teacher-student dyads: student engagement and teacher emotions

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The contributions of each author (author statement, CRediT) to the manuscript are stated in Appendix H

ABSTRACT

Aims. This study aims to investigate the dyadic relationships between teachers' emotions and individual students' engagement in real-time classrooms, and the moderating effect of teachers' involvement level. **Methods.** The sample consisted of 20 teachers and 80 target students in Taiwanese public primary schools. Teachers in this study reported their emotions and students' engagement at the end of each lesson for a calendar week (n_{ti}=249). T-test and multilevel structural equation models were specified to answer the research questions. **Results.** Findings showed that teachers' involvement level is correlated with teacher-student relationships. Teachers rated having a closer and more conflictual relationship with students in the high-involvement group. Additionally, teachers' involvement level moderated the relationship between student engagement and teachers' emotions. **Conclusion.** This study expands our understanding of teacher-student dyads in the real-time classroom by demonstrating the effect of individual students' engagement on teachers' positive and negative emotions while accounting for teachers' involvement levels.

Keywords: Teacher emotions; Student engagement; Teacher-student relationship; Teacher involvement

7.1 INTRODUCTION

Teacher and student emotions play an essential role in students' learning and in teachers' teaching careers and well-being. Investigating teachers' emotions is important for understanding teachers' needs and difficulties (Schutz, 2014). Although research has mostly focused on the dynamics between teachers and all students within the classroom, teachers respond to individual students differently, which, in turn, has an impact on both teachers and students (Newberry & Davis, 2008). To understand how students and teachers can reciprocally foster each other's positive emotional experiences in the classroom, it is crucial to study teacher-student dyads regarding their relationships and behaviour in the classroom. However, to date, little is known about teacher-student dyads regarding their behaviour, relationship quality, and emotional experiences in the classroom.

In recent years, interest in understanding emotional experiences in school settings has been growing, with researchers addressing the importance of linking teachers' emotions with their students in the classroom. Theoretical models of teacher emotions and well-being suggest that teachers' emotions reflect their reactions to particular students' behaviours in the classroom (Frenzel, 2014; Spilt et al., 2011). Negative student behaviours do not necessarily lead to teachers' negative emotions, but

it is important to consider how teachers judge the dyadic relationship with a student. However, most research has focused on finding the link between students' negative behaviour (e.g., teachers' perceptions of student disruptive behaviour) and higher levels of teachers' stress and burnout, and low well-being. Using the lens of fostering positive emotions while decreasing negative emotions, we proposed that studying the mechanisms underlying the effect of individual students' positive behaviour (e.g., engagement) on teachers' emotions while considering the teacher-student relationship is important. Additionally, since teachers might experience high conflict and high closeness with students they perceive as having relatively more disruptive behaviour (Spilt & Koomen, 2009), the meaningful effort teachers put into certain students may explain teachers' emotional reactions to students' behaviour (Spilt et al., 2011).

Given the scarcity of research on the teacher-student dyads focusing on teacher emotions and student engagement, this study aimed to investigate teacher emotions and individual student engagement in the real-time classroom considering the teacher-student relationship as the context.

7.1.1 Teacher emotions in the classroom

Teacher emotions, like student emotions, are prevalent in school settings. 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, 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 (Donker et al., 2020; Goetz et al., 2015). Studies (Banerjee et al., 2017; Frenzel et al., 2020) suggest that teachers' positive emotions could lead to the students' positive outcomes and help build a positive classroom, implying 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 (de Ruiter et al., 2020; Spilt et al., 2011), little is known about the mechanism underlying this.

7.1.2 Student engagement and teacher emotions

Student engagement, as the reflection of student motivational behaviour in the classroom, could play an important role in students' achievement and teachers'

emotions (Frenzel, 2014). It is defined as 'the quality of a student's connection or involvement with the endeavour of schooling' (Skinner et al., 2009, p.494). As an active and observable element of students' presence in the classroom, student engagement is commonly studied as a multi-dimensional construct that comprises different dimensions, such as 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.

Frenzel (2014) pointed out that teachers' perceptions of students' motivational behaviour (e.g., student engagement) are one of the important factors (achievement behaviour, motivational behaviour, socio-emotional behaviour, relational behaviour) in the classroom that affect 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 evokes teachers' evaluation of how

successful their teaching is and further appraises 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 judge their teaching (Jacob et al., 2017).

Empirical evidence shows that perceived student engagement plays a crucial role in teachers' emotions. As a cross-sectional study indicated, 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, and student enjoyment at time 1 predicted teachers' enjoyment via teacher-perceived student engagement at time 2. Thus, when teachers feel students are behaviourally and emotionally engaged in the learning activities, they could experience higher levels of positive emotions and lower levels of negative emotions.

Applying the 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 greater students' 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 still needed. Moreover, previous research has used teachers' ratings of the general classroom rather than individual students, which may have overlooked the effects of individual students on teachers' emotions. We extended previous studies by investigating the effects of teachers' perceptions of 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.

7.1.3 Teachers' perceptions of individual students' behaviour

Classroom dynamics include teachers interacting with the whole class and with individual students. Although the effect of teachers' different expectations of individual students has been capturing researchers' attention for a long time (Denessen et al., 2020), the effect of individual students on teachers, especially teachers' emotional experience, is relatively scarce.

Models of teachers' emotions and well-being postulate that the events (student behaviour) teachers face in their daily lives in school settings trigger teachers' emotional experiences (Frenzel, 2014; Spilt et al., 2011). Research has paid attention to the relationship between teachers' emotions and general students' behaviour, especially teachers' perceptions of student misbehaviour or disruptive behaviour (Aldrup et al., 2018). An interesting question remains: Since not all students act the same in the real-time classroom, whose behaviour matters more to teachers? Evidence shows that not all students receive equal teachers' attention in the classroom, implying different involvement of teachers. Moreover, the research has found that only several students

capture preservice teachers' attention while teaching using the eye-tracking method (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, the findings indicated that teachers tend to react with negative emotions to students they perceive to have more disruptive behaviour in the past (de Ruiter et al., 2020). This research demonstrates that teachers may have stronger negative emotions when reacting to a negative event involving students perceived as more disruptive in the past.

Thus, individual students' behaviour in the classroom may trigger teachers' different intensities of emotional responses. 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.

7.1.4 Teachers' involvement and teacher-student 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 important 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 than in 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, it seems that primary school teachers could also 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 believed that teachers feel a closer relationship when they have a low level of conflict with a student in general; however, empirical research has indicated

that teachers could feel close but conflictual with the same student (Spilt & Koomen, 2009). This reveals the complex nature of the teacher-student relationship, indicating that feeling close and conflictual to a person are not mutually exclusive.

In this vein, teachers' mental representation of their relationship with a particular student could involve how much effort they exert and how meaningful their action is. A study exploring primary school teachers' conceptions of closeness via classroom relationships pinpointed three factors (i.e., negotiating personality, child's press for the relationship with the teacher, and dealing with challenges) that shape teachers' experiences of relationship with students and interaction with individual students (Newberry & Davis, 2008). From the teachers' perspective, the match-mismatch between their 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, which 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 call teachers' attention 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 teachers feel urged by the student to build a closer relationship. Although this study focused mainly on a close relationship between teachers and students but not the conflictual relationship, it implies that teachers' involvement and 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 guide their actions to build the relationship and their responses to a student.

Together, previous findings have supported that the teacher-student relationship is crucial for both teachers and students. However, the teacher-student relationship with teachers' emotional experiences in the classroom may reflect how much attention, involvement, or effort teachers direct toward individual students. To obtain further support, it is necessary to examine the role of teachers' involvement with the students during teaching on their emotional experiences and whether this reflects teachers' idea of their relationship with their students.

7.2 THE PRESENT STUDY

As shown in the proposed model (see Figure 20), 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

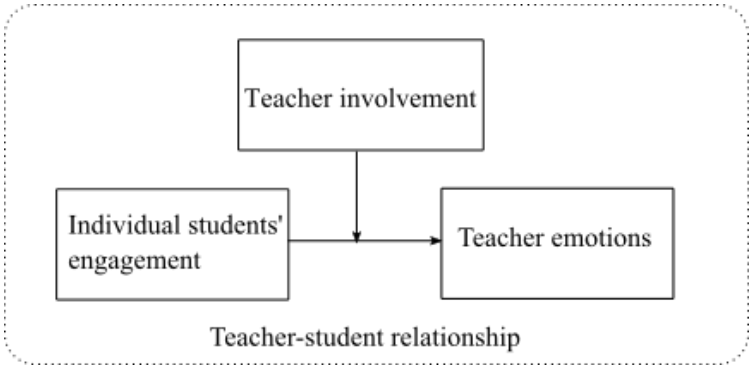
with their students. Inspired by the theoretical work of Spilt et al. (2011) and Frenzel (2014), we proposed that individual students' engagement plays an important role in teachers' emotions, especially in teachers' positive emotions. Meanwhile, teachers' mental representation of their involvement level with a student plays a role in the relationship between teachers' perception of their students' engagement and their emotions. Specifically, we examined the following research questions:

1. How do teachers nominate individual students (teacher-student relationship/student academic performance)?
2. How does teacher-perceived individual student engagement predict their emotions?
3. To what extent does students' teacher involvement moderate the effect of student engagement on teacher emotions?

To reflect the different teacher-student links in teachers' emotions elicited by students' motivational behaviour (student engagement), we designed our study to ask teachers to report on four target students' engagement during each lesson. Four target students in this study were selected according to teachers' involvement levels (relatively greater/lower attention they paid to particular students) in previous lessons from teachers' nomination of students. We expected that teachers' selection of their students

according to their involvement level would reflect their relationship with their students but not necessarily students' academic performance. We assumed that teachers might have higher closeness or conflictual relationships with students with whom they were involved relatively more in the previous lessons. Further, we anticipated that teachers' involvement levels moderate the relationship between individual students' engagement and teacher emotions.

Figure 20 *Conceptual model (Manuscript 3)*



7.3 METHOD

7.3.1 Participants and Procedure

Micro-longitudinal research was conducted in two cities in Taiwan. Ethical approval was obtained before the recruitment. In total, the head teachers of eight primary schools agreed to join the research. Homeroom teachers 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 P.-H. Li et al., 2022).

In total, 20 homeroom teachers (Male = 2, Female = 18) and their 308 students (Male = 164, Female = 144) from Years 4 to 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 those teacher-nominated students were selected and included from each classroom to participate in the current research, i.e., two students with whom the teacher was relatively involved more and two students with whom the teacher was involved relatively less in the lessons. Therefore, participants in this study included 20 homeroom teachers and their 80 individual students (out of 308 students).

During the research, teachers rated themselves and 80 students (46 boys and 34 girls) regarding emotions and engagement. Similarly, students also rated themselves and their homeroom teachers. Teachers' age ranged from 28 to 55 years old (M = 43.05, SD = 9.01) and 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, teachers reported a positive teacher-student relationship with target students (see Table 11).

Table 11 *Participant characteristics (Manuscript 3)*

		M	SD	N	%
Teacher (N=20)	Gender				
	Male			2	10
	Female			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		
Student (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	
	T-S relationship				
	Closeness	3.83	0.59	80	
	Conflict	1.75	0.89	80	

7.3.2 Measures

Teachers completed a short-form questionnaire for each student who participated in the study that included questions assessing the teacher-student relationship. Information on students' academic performance was collected. During the intensive data-collection

period, teachers reported their own emotions throughout each lesson and the engagement of the four target students. Students were unaware that they were target students.

Teachers' perceptions of the teacher-student relationship

The teacher-student relationship was measured with 15 items on a 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. The Cronbach's α and omega coefficients using the current sample ranged from 0.87 to 0.93 for closeness and conflict in this study.

Teacher emotions

Teachers' lesson-specific emotions were measured using eight discrete positive and negative emotions: enjoyment, pride, relaxation, calmness, anger, anxiety, boredom, and disappointment. We selected various common and easily understood emotions in primary school for teachers and students. Thus, we covered both the high-activation

emotions (e.g., enjoyment, pride, anger, anxiety) and low-activation emotions (e.g., relaxation, calmness, boredom, disappointment) for both positive and negative emotions (consistent with activating and deactivating emotions, following both activation and valence dimensions of emotions, Pekrun, 2006) in the current study. Categorising these discrete emotions into positive and negative emotions is supported by a previous Taiwanese study on teacher emotions (Y.-F. Chang & Cherng, 2017). The reliability of teacher emotions (Cronbach α and McDonald's omega) ranged from 0.59-0.92 at different levels (please see Li et al., 2022 for information).

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-reported questionnaire "Engagement Versus Disaffection with Learning: Teacher Report" (Skinner et al., 1990, 1998, 2009; Wellborn, 1991). Teachers rated students' engagement during each lesson to assess to what extent students engaged in their lesson activities and tasks. The behavioural engagement was assessed using four items measuring students' persistence, effort, and attempts in learning tasks or activities. The emotional engagement was assessed using four items that concern students' interests and enthusiasm while participating in learning tasks (Skinner et al.,

1998). We adjusted some wording to fit the use in the real-time classroom. The reliability (Cronbach's α and McDonald's omega) in the present study ranged from 0.84-0.96 across levels (lesson level, student level, teacher level) for behavioural engagement, and 0.89-1.00 for emotional engagement.

7.3.3 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. Teachers' lesson data were merged with each individual student's lesson data. To understand the effect of teacher self-report emotions in response to individual students' engagement considering different levels of teacher involvement students received, we applied a wide dataset format to analyse the data (see Figure 21). Thus, in this study, lesson-specific reports from teachers and individual students (Level 1) were nested within the teachers/classroom (Level 2, see Mehta & Neale, 2005).

We first examined 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 (L. K. Muthén & Muthén, 1998-2017). Bayesian estimation enables researchers to obtain robust and accurate estimations with a small sample. In this study, although the

size of lesson-specific data was sufficient (Level 1), the sample size of classrooms was relatively small (20 classrooms at Level 2). Following McNeish (2019), we applied admissible-range-restricted priors. 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 trace plots with the potential scale reduction value and auto-correlation plot of parameters (Kruschke, 2015).

Multilevel structural equation models were specified separately for teachers' positive and negative emotions. We first estimated intra-class correlations (ICC) to investigate the variance in teachers' positive and negative emotions attributed to different levels. We then conducted models to examine the relationship between individual students' engagement and teachers' emotions. Then, we examined the possible moderation effect of teachers' level of involvement on the association between individual students' engagement and teachers' emotions. This was done by setting a fixed path (engagement to teacher emotions) based on the teachers' involvement level. We modelled this moderation effect at both Level 1 and Level 2 to examine the moderation effect at both levels.

Figure 21 *Schematic structure of the wide dataset (Manuscript 3)*

Teacher id	Lesson id	Teacher positive emotion	Target student 1 Engagement	Target student 2 Engagement	Target student 3 Engagement	Target student 4 Engagement
1	101	4.00	4.25	4.75	4.50	3.50
1	102	3.25	3.00	4.25	3.75	4.50
1	103	5.00	4.50	3.75	4.50	4.25
2	201	3.50	3.25	3.50	4.75	4.25
2	202	4.75	5.00	4.00	3.50	3.25
2	303	4.25	4.00	3.50	4.25	4.50
…	…	…	…	…	…	…
20	2010	3.50	3.50	4.25	4.50	4.25
20	2011	4.25	3.25	4.50	3.75	4.50

Note. The dataset presents the structure of the wide dataset format used in this study with virtual values. Columns 3-7 indicate the average scores of each measurement in a lesson.

7.4 RESULTS

7.4.1 Descriptive analysis

Table 12 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 (Level 1). Generally, teachers scored relatively high on positive emotions across lessons (M = 3.62) and lower on teachers' negative emotions (M = 1.86). Teachers' mean 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 each target student's engagement, and a negative relationship between teachers' negative emotions and target students' engagement.

Table 12 *Descriptive statistics and correlations for study variables (Manuscript 3)*

	M	SD	$ICC_{(b)}$	Correlations								
				(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Teacher emotions												
(1) TPE	3.62	0.62	0.59									
(2) TNE	1.86	0.69	0.58	-0.61***								
Engagement												
(3) TS1ENB	3.77	0.73	0.61	0.46***	-0.37***							
(4) TS1ENE	3.86	0.73	0.60	0.47***	-0.38***	0.86***						
(5) TS2ENB	3.72	0.72	0.68	0.55***	-0.34***	0.43***	0.46***					
(6) TS2ENE	3.80	0.73	0.63	0.56***	-0.41***	0.46***	0.54***	0.87***				
(7) TS3ENB	3.51	0.70	0.60	0.45***	-0.22***	0.29***	0.31***	0.44***	0.39***			
(8) TS3ENE	3.51	0.75	0.52	0.44***	-0.30***	0.27***	0.33***	0.43***	0.41***	0.86***		
(9) TS4ENB	3.60	0.64	0.61	0.44***	-0.22***	0.22***	0.27***	0.46***	0.44***	0.60***	0.52***	
(10)TS4ENE	3.57	0.68	0.58	0.44***	-0.26***	0.18**	0.27***	0.49***	0.47***	0.52***	0.59***	0.83***

Note: TPE = teacher positive emotions, TNE = teacher negative emotions, TS1ENB/TS2ENB/TS3ENB/TS4ENB = teachers' perceptions of student 1/2/3/4's behavioural engagement, TS1ENE/TS2ENE/TS3ENE/TS4ENE = teachers' perceptions of student 1/2/3/4's emotional engagement. ICC(b) = Between/ (Within + Between). $^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$.

The intraclass correlation (ICC) demonstrated that between-lesson variability of teacher emotions ranged from 0.58 to 0.59, indicating that the majority of the variance was from variation between classrooms, although a substantial variance accounted for between-lesson variation (approximately 0.41 and 0.42 for positive and negative emotions). Thus, variance can be attributed to both situational (lesson) variation as well as characteristics of the class (or teachers). Intriguingly, although the between-classroom variability in teacher-reported individual students' engagement on each student was more than 0.50, it seems that teachers rated each student's engagement differently. For example, almost half of the variance could be attributed to between-lesson variation when considering the emotional engagement of student 3, while only

less than 0.40 of the total variances could be attributed to between-lesson variation when considering student 1 and student 2.

7.4.2 Characteristics of individual students

First, individual students' characteristics were examined according to the teacher involvement level. As mentioned before, this study included four individual students (= target students) in each classroom selected by teachers' nomination according to teachers' past involvement levels. Two out of the four students per teacher were grouped as receiving relatively high teacher involvement in previous lessons, while the remaining two individual students per teacher received relatively less teacher involvement in previous lessons. We then examined whether students' academic performances and their relationships with teachers differed based on different teachers' involvement levels (see Table 13).

Regarding students' academic performance, the results showed no significant difference ($t(77) = 0.82$, $p = 0.414$) between individual students with a relatively high level of teacher involvement and students with a relatively low level of teacher involvement. However, compared to the group with comparatively higher teacher involvement ($M = 83.09$), students' academic performance was slightly higher in the

group with relatively lower teacher involvement (M = 85.22). Intriguingly, it reflects the individual differences between teachers' definitions regarding selection criteria.

Concerning the student-teacher relationship, both closeness and conflict were analysed. The results showed that teachers reported having a closer relationship with students with whom they were relatively involved more ($t(78) = -2.14$, $p = .036$). Interestingly, teachers also reported having higher conflict levels with students in the high-involvement group ($t(78) = -2.96$, $p = .004$). This is aligned with our expectation that the teacher involvement level reflects teachers' relationship with individual students in the classroom.

Table 13 *t-test for student characteristics (Manuscript 3)*

	Low involvement		High involvement		
	M	SD	M	SD	*t*-test
Academic performance	85.22	8.30	83.09	14.03	0.82
Closeness	3.69	0.48	3.96	0.66	-2.14*
Conflict	1.47	0.65	2.03	1.01	-2.96**

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

7.4.3 How does teacher-perceived individual student engagement predict their emotions?

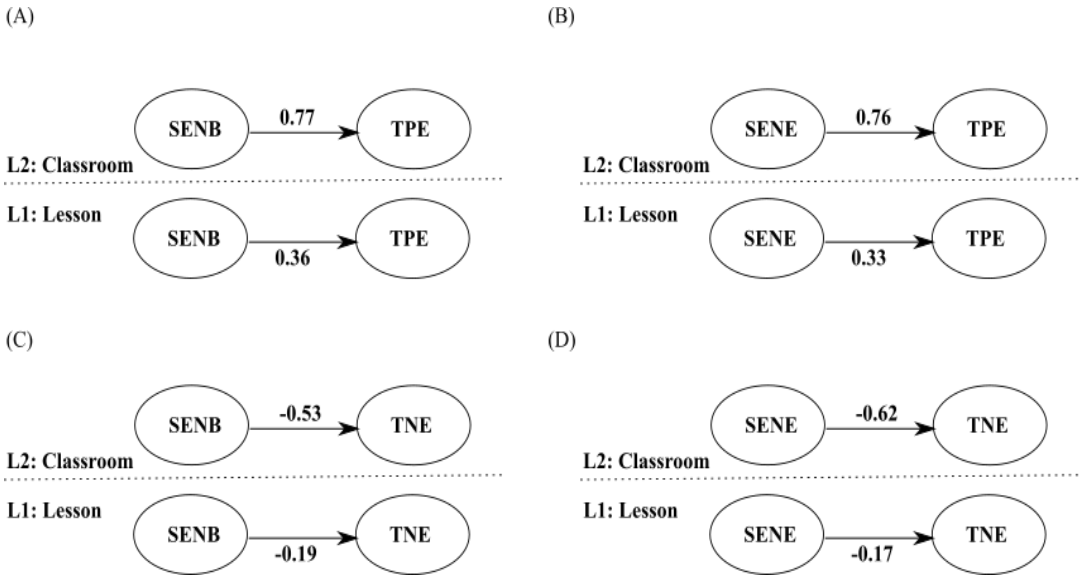
As shown in Figure 22 (A and B), a similar pattern was found for the effects of teacher-perceived individual students' behavioural and emotional engagement on teachers'

positive emotions. The results revealed that overall teacher-perceived student engagement of target students predicted teachers' positive emotions. The higher the teacher-perceived target students' behavioural (lesson: β = 0.36, C.I. [0.24, 0.47], classroom: β = 0.77, C.I. [0.50, 0.90]) and emotional engagement (lesson: β = 0.33, C.I. [0.21, 0.44], classroom: β = 0.76, C.I. [0.49, 0.90]), the higher teachers' positive emotions at both the lesson and classroom level.

In terms of teachers' negative emotions, as shown in Figure 22 (C and D), the results for teachers' negative emotions revealed that higher target students' average behavioural engagement (lesson: β = -0.19, C.I. [-0.31, -0.06], classroom: β = -0.53, C.I. [-0.78, 0.11]) and emotional engagement (lesson: β = -0.17, C.I. [-0.29, -0.04], classroom: β = -0.62, C.I. [-0.83, -0.25]) were linked with lower teachers' negative emotions.

Teachers' overall perceptions of target students' engagement in the classroom predicted both teachers' positive and negative emotions but in different directions. When teachers rated their students as more engaged in class, they were more likely to experience a higher level of positive emotions and a lower level of negative emotions.

Figure 22 *Student engagement and teacher emotions (Manuscript 3)*



Note: TPE = teacher positive emotions. TNE = teacher negative emotions. SENB = teacher-perceived students' average behavioural engagement. SENE = teacher-perceived students' average emotional engagement.

7.4.4 The moderating effects of teachers' involvement on the relationship between teachers' perceptions of student engagement and teacher emotions

Teacher-reported student engagement and teachers' positive emotions

As shown in Figure 23, the results revealed that teachers' perceptions of individual students' engagement in the lesson significantly predicted teachers' positive emotions at the lesson level regardless of the relative teacher involvement (Behavioural engagement: S1: β = 0.14, C.I. [0.05, 0.22]; S2: β = 0.12, C.I. [0.05, 0.20]; S3: β = 0.15, C.I. [0.06, 0.23]; S4: β = 0.13, C.I. [0.06, 0.20]; Emotional engagement: S1: β = 0.12, C.I. [0.04, 0.20]; S2: β = 0.12, C.I. [0.04, 0.19]; S3: β = 0.14, C.I. [0.05, 0.22]; S4: β =

0.12, C.I. [0.04, 0.19]). However, only teachers' perceptions of the high teacher involvement group significantly predict teachers' positive emotions at the classroom level for both behavioural (S1: β = 0.38, C.I. [0.16, 0.58]; S2: β = 0.38, C.I. [0.16, 0.58]; S3: β = 0.13, C.I. [-0.09, 0.34]; S4: β = 0.12, C.I. [-0.08, 0.31]) and emotional engagement (S1: β = 0.35, C.I. [0.14, 0.52]; S2: β = 0.35, C.I. [0.14, 0.53]; S3: β = 0.14, C.I. [-0.08, 0.34]; S4: β = 0.13, C.I. [-0.08, 0.33]).

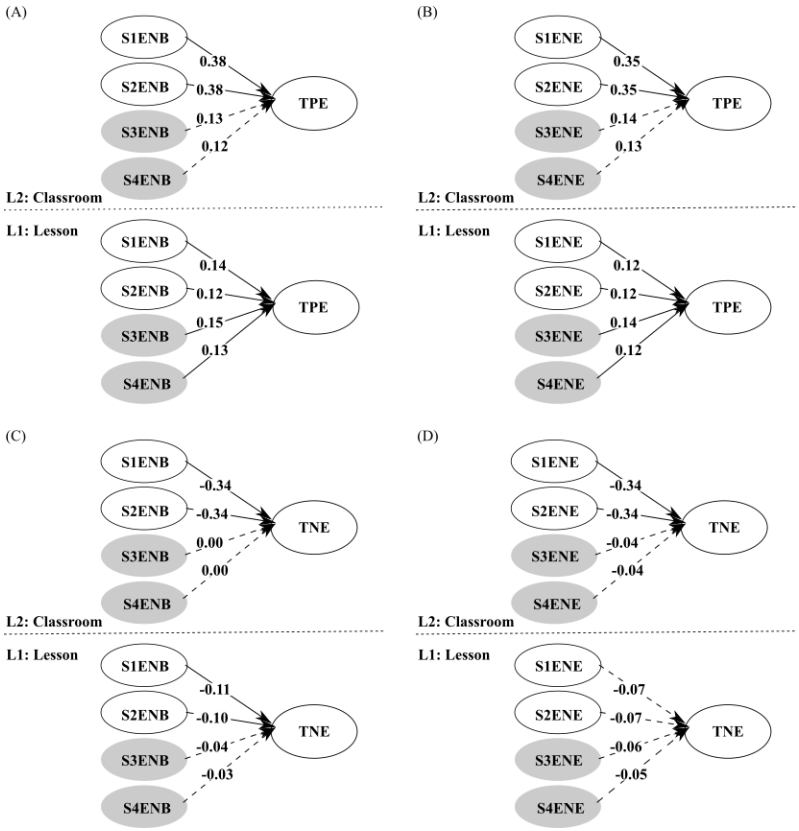
Thus, teachers' involvement level across classes moderated the effect of teachers' perceptions of student engagement on teachers' positive emotions, suggesting that teachers' perceptions of student engagement in teachers' positive emotions depended on the level of involvement from teachers. At the classroom level, when teachers who perceived that individual students who received relatively greater teacher attention and involvement were actively engaged in the learning activities behaviourally and were enthusiastic about the activity, they were more likely to report a higher level of positive emotions.

Teacher-reported student engagement and teachers' negative emotions

For teachers' negative emotions, the results (see Figure 23) demonstrated teachers' different involvement levels moderated the effect of teachers' perception of individual students' behavioural engagement on teachers' negative emotions at both the lesson

level (S1: β = -0.11, C.I. [-0.20, -0.02]; S2: β = -0.10, C.I. [-0.18, -0.02]; S3: β = -0.04, C.I. [-0.12, 0.05]; S4: β = -0.03, C.I. [-0.11, 0.05]) and the classroom level (S1: β = -0.34, C.I. [-0.56, -0.06]; S2: β = -0.34, C.I. [-0.56, -0.06]; S3: β = 0.00, C.I. [-0.26, 0.25]; S4: β = 0.00, C.I. [-0.24, 0.23]). That is, teachers who perceived that students who received relatively greater involvement were actively engaged in the learning activities behaviourally (e.g., participating in the discussion) reported a lower level of negative emotions across lessons and classrooms. Interestingly, in terms of teacher-perceived individual students' emotional engagement, the results indicated that teachers' involvement level moderated only the effect of emotional engagement on teachers' negative emotions at the classroom level (S1: β = -0.34, C.I. [-0.53, -0.09]; S2: β = -0.34, C.I. [-0.53, -0.09]; S3: β = -0.04, C.I. [-0.28, 0.21]; S4: β = -0.04, C.I. [-0.27, 0.20]). No effect was found at the lesson level.

Figure 23 Moderation effect of teacher involvement level



Note. The dotted lines indicate credible intervals that include zero. TPE = teacher positive emotions. TNE = teacher negative emotions. S1ENB/S2ENB = teacher-perceived student 1's and student 2's behavioural engagement level. S3ENB/S4ENB = teacher-perceived student 3's and student 4's behavioural engagement level. S1ENE/S2ENE = teacher-perceived student 1's and student 2's emotional engagement level. S3ENE/S4ENE = teacher-perceived student 3's and 4's emotional engagement level.

7.5 DISCUSSION

This study focused on an understudied topic in current primary school settings in Taiwan. It investigated teachers' emotional experiences as a function of individual students' engagement while considering teachers' involvement with students. Extending previous research that has focused on students perceived as having more disruptive

behaviour, we proposed that teachers' mental representation of their relationships with individual students is not based purely on previous negative student behaviour (e.g., student disruptive behaviour). Overall, our findings somewhat supported our expectation that teachers' involvement level with individual students reflects the dyadic teacher-student relationship. Moreover, teachers' involvement was related to the effect of student engagement on teachers' emotions.

7.5.1 Characteristics of individual students

Teachers' relationships with individual students, especially conflict with students, differed based on their involvement level in previous lessons. Students having higher conflict and higher closeness with teachers were more likely to receive more attention from teachers in the lesson. This implies that there might be a stronger connection between teachers and individual students with whom teachers were involved more in the previous lesson.

Our findings align with previous research indicating that teachers can simultaneously have a close and conflictual relationship with the same student (Spilt & Koomen, 2009). Primary school homeroom teachers spend most of their time with students in lessons, although they interact informally during break time. Although

student achievement is one major intrinsic reward for teachers, teachers value interactions with their students regardless of specific outcomes (Plihal, 1982).

7.5.2 Teachers' different involvement levels moderate the effect of teachers' perceptions of student engagement on teacher emotions

In our analysis, we found that target students' overall engagement was associated with teachers' emotions in the models. Interestingly, the interaction between teachers' involvement level and student engagement predicted teachers' emotional experiences. Specifically, teacher involvement level moderated the effect of students' behavioural and emotional engagement on teachers' positive emotions at the classroom level and the effect of student behavioural engagement on teachers' negative emotions at both the lesson level and classroom level.

Our data suggested that individuals' engagement (both emotional and behavioural) in each lesson matters for teachers' positive emotions. However, differences exist across classrooms. Higher teachers' average perceptions of student engagement and teacher involvement with different individual students led to greater average positive emotions. This reflects the findings of previous research that student engagement mainly predicts teachers' positive emotions (Becker et al., 2015; Hagenauer et al., 2015).

Consistent with our expectation, we found that the teacher involvement level moderates the effect of student behavioural engagement on teachers' negative emotions at both levels. This indicates that individual student behavioural engagement decreases teachers' negative emotions when teachers perceive they are involved more or pay more attention to the students. Intriguingly, we found inconsistency between the effect of individual students' emotional engagement on teachers' negative emotions at the lesson level. Although students' emotional engagement had the opposite direction with teachers' negative emotions at the lesson level, no clear effect was found. This finding implies that the student's behavioural engagement may count more for teachers' negative emotions in the lesson, as it is relatively explicit for teachers to observe during classroom interactions.

Note that due to the consideration of the complexity of the current design (e.g., included both teachers' self-reported emotions and teacher-rated each student's engagement in the same lesson) and the primary focus of teacher emotions, this study used the wide dataset format to analyse the relationships between teacher emotions and perceived individual students' engagement. However, the results should be interpreted with caution, as this might overlook the potential cross-classified structure that the target students were nested within teachers, which may cause bias in standard error

estimation (e.g., Luo & Kwok, 2009). In this study, although there was still around 25-28% variance that could be attributable to teachers' rating of the four students (based on the ICC), the majority of student engagement variance is attributable to the lesson and classroom(teacher) level (around 72-75%) in the cross-classified model. In addition, the primary dependent variable, teacher emotions, had almost no variance at the student level (teacher emotions not varied because of different students but because of teachers and lessons), showing a meaningful analysis at the lesson and classroom level (Gooty & Yammarino, 2011).

7.6 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 were rich, the sample size in the present study was relatively small, with only 20 teachers and 80 individual students from the same cultural background. Also, as was indicated in the discussion, the analytical approach based on the design and the primary focus helped answer the questions but may have restrictions. The current design and analysis thus need to be expanded. Taken together, additional research is required to replicate our findings using larger sample sizes in various cultural contexts.

Although we focused on teachers' and students' spontaneous reports of their emotional experiences in each lesson, we did not investigate events (e.g., students answer questions) that triggered teachers' emotions. Future studies could investigate the trigger of teachers' emotions to explore the link between a specific event 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 perceived 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.

7.7 Conclusions and implications

In conclusion, the findings of this study indicate that the teacher-student dyad in the real-time classroom is a crucial issue, and 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 schools, considering teachers' involvement levels. The findings suggested that teachers' involvement is related to their evaluations of their relationships with individual students. Consequently, teachers' awareness or perceptions of their effort may reflect their relationships with the individual student and further contribute to the teacher-student relationship. 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 dyadic 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, calmness, and relaxation from lesson to lesson, regardless of the involvement level teachers perceived. This implies that improving students' engagement level or creating a positive climate in the classroom could help teachers

accumulate positive emotional experiences throughout their teaching career, which may further contribute to their overall well-being.

Another implication regards the results that teachers' involvement level moderates the effect of individual students' engagement on teachers' positive emotions at the classroom level and negative emotions at both the lesson and classroom levels. The findings of this study indicated that when teachers see that students to whom they give more attention engage in the lesson, they feel a higher level of positive emotions overall and a lower level of negative emotions at the lesson and classroom levels. 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.

CHAPTER 8. DISCUSSION AND CONCLUSION

8.1 CHAPTER INTRODUCTION

The overarching aim of this thesis was to investigate teachers' momentary emotional experiences with their students concerning teacher-student well-being in Taiwan. The thesis emphasises the importance of teachers' momentary emotional experiences in school settings. As discussed in Chapter 2, this research project is based on a framework synthesising the existing theories and previous empirical studies. Following the broaden-build-theory (Fredrickson, 1998, 2004) and previous researchers' theoretical models (Frenzel, 2014; Spilt et al., 2011), the framework of this research takes a positive but reciprocal approach to address the dynamic nature of positive and negative emotional experiences of teachers and students in Taiwan. Additionally, the framework expands previous research to discuss the role of individual students (target students) through an innovative lens. Overall, the conceptual model provides the foundation for research questions for three interconnected studies (see Figure 4). Study 1 concerns the mechanism of teachers' momentary emotional experiences and well-being. The role of teachers' momentary emotions was evaluated as a bridge linking their situational experiences with students and their evaluation of their work-related well-being and general well-being. Study 2 expands the perspectives of Study 1 and focuses on the

interplay between teachers' emotions and all students' emotions in the classroom. To do so, Study 2 integrated teacher reports and student reports about their emotions in real-time in the classroom to investigate the emotional contagion and reciprocal relationship between primary school teachers and their students from one lesson to another. Study 3 is based on the research framework and previous research that focused on the potential role of individual students using a lens that reflects the role of the teacher-student relationship and addresses teachers' involvement. To do so, Study 3 investigated the teacher-student dyads regarding teachers' perceptions of individual students' engagement and teachers' emotions.

Together, these three studies respond to the gaps in the previous research by addressing the positive perspective of teachers' emotional experiences in school settings. Designing the empirical work as a micro-longitudinal study, following teachers and their students from one lesson to another, minimised retrospective bias and enhanced contextual closeness. Specifying state-of-the-art multilevel structural equation models (MSEM) and applying the Bayesian estimator, novel findings emerged. To the best of my knowledge, this is the first micro-longitudinal study utilising the ecological momentary assessment method to investigate primary school teachers' emotional

experiences and incorporating the emotions of teachers, students in general and target students.

This thesis expands knowledge in four ways. First, the findings contribute to the literature on teachers' emotional experience and well-being field by connecting different concepts to build cyclical relationships of teachers' emotional experiences. Second, the findings in this thesis expand the understanding of momentary emotional experiences in Taiwanese primary schools. Third, this thesis can contribute to policy regarding student behaviour factors and the interplay between teachers and students. Furthermore, the findings of this thesis increase understanding of teachers' emotional experiences with particular students considering teachers' perceptions of their involvement and students' active engagement.

This chapter summarises and interprets the main results from previous finding chapters (three manuscripts in Chapters 5, 6 and 7), draws connections between the three studies, and further highlights the strengths, limitations, and implications of the overall research project. This chapter starts with a summary and discussion of the main findings, then reflects on the limitations of the research. This chapter then discusses the suggestions and implications of this research.

8.2 MAIN FINDINGS

This section summarises and discusses the main findings of this thesis in relation to the overall research aims: (1) investigating teachers' momentary emotional experiences, their perceptions of student antecedents, and their day-to-day work-related well-being and general well-being, (2) investigating emotional contagion and its directionality between primary school teachers and students, and (3) the association between teachers' perceptions of individual students' engagement and teachers' emotions in teacher-student dyads. First, teachers' emotional experiences from teachers' perspectives in school settings will be discussed, followed by a discussion regarding the links between momentary emotions and work-related and general well-being. Then, the situation-specific emotional contagion and reciprocal relationships between teachers and students will be addressed. Lastly, the dyadic relationship between teachers' involvement with individual students will be discussed, as well as teachers' emotions and individual students' engagement.

8.2.1 Emotional experiences of primary school teachers and student behaviour

The first aim of this thesis was to investigate teachers' momentary experiences and their perception of day-to-day work-related well-being and their general well-being as a whole. The first corresponding research question addresses the relationship between

teachers' momentary emotional experiences and teachers' perceptions of student behaviour. This aim was mainly addressed in Study 1 and further extended in Study 3. In Study 1, student behaviours as the factors of teachers' emotions were based on teacher-rated student motivational behaviour (i.e., student engagement) and social-emotional behaviour (i.e., perceived student disruptive behaviour) that reflects teachers' evaluation of all students in the classroom. Study 3 addresses the function of positive indicators of student behaviour (i.e., student engagement). Teachers' detailed reports on individual students' engagement were used to investigate the relationship between student engagement and their in-class emotions. Next, the results of the relationship between student behaviour and teacher emotions will be discussed, first focusing on teacher-perceived student disruptive behaviour followed by student engagement.

Teacher emotions and perceived group-level student disruptive behaviour

Study 1 investigated teachers' evaluation of student social-emotional behaviour (i.e., perceived student disruptive behaviour) for the whole class, which links this thesis with previous studies. Consistent with prior studies concerning discrete emotions (i.e., enjoyment, anger, and anxiety), teacher-perceived students' disruptive behaviour predicts teachers' emotions (e.g., Aldrup et al., 2018; Becker et al., 2015; de Ruiter et al., 2020; Hagenauer et al., 2015). Perceived higher levels of interference and

disciplinary problems in the classroom primarily predict higher levels of teachers' lesson-specific negative emotions.

Intriguingly, contrary to the findings of Aldrup et al. (2018), Becker et al. (2015), and Hagenauer et al. (2015), who found that classroom indiscipline predicted a lower level of teachers' enjoyment, significant relationships between teachers' positive emotions and teacher-perceived student disruptive behaviour were not found in this research in which positive and negative emotions were included in the same model. It may reflect that teachers' perceptions of disciplinary problems in the classroom do not have significant relationships with every type of positive emotion but are more related to high-activated emotions like enjoyment. Moreover, either the design of this research (e.g., repeated measures at the end of each lesson versus cross-sectional/daily report) or the participants (e.g., primary homeroom versus secondary school teachers) are quite different from previous studies. Additionally, as found in a study by de Ruiter and colleagues (2020), teachers' appraisals of events may be coloured by their previous perceptions of particular students' disruptive behaviour. Thus, teachers may act emotionally stronger toward specific students than toward students in general. Even when teachers rate the same levels of perceived student disruptive behaviour, they

might have different emotions subsequently due to differentiated secondary appraisals such as the control level of the incidents (Chang & Davis, 2009).

Teacher emotions and perceived group-level student engagement

In Study 1, teachers' perceptions of student engagement were also included as a predictor for teachers' positive and negative emotions. The findings demonstrated that a teacher-perceived higher level of overall student engagement predicts higher teacher positive emotions and lower teacher negative emotions. Similar to previous studies (Becker et al., 2015; Frenzel et al., 2020; Hagenauer et al., 2015), student engagement plays a vital role in increasing teachers' positive emotions (e.g., enjoyment) and decreasing teachers' negative emotions (e.g., anger).

From a positive and constructive perspective, nurturing student engagement could increase teachers' positive emotions and decrease their negative emotions. This implies the potential protective role of teachers' perceptions of students' engagement because it is an index or criteria for teachers to judge to what extent the lesson is successful (Jacob et al., 2017). The important role of student engagement in teachers' emotions was again addressed based on the findings of target students in Study 3, which will be discussed in later sections.

Summary of findings regarding student behaviour and teacher emotional experiences

Overall, the findings of this thesis indicate that teachers' perceptions of students' disruptive behaviour (social-emotional behaviour) predict teachers' negative emotions but not positive emotions in the Taiwanese primary school context. In contrast, teacher-perceived student engagement (motivational behaviour) predicts teachers' positive emotions and negative emotions during teaching. As teachers tend to experience a mixture of emotions during teaching, the findings of this study provide insight into how their perceptions of students' behaviour impact their positive and negative emotions from a broader perspective rather than focusing on specific discrete emotions (e.g., enjoyment, anxiety, anger) as in previous research (e.g., Becker et al., 2015; de Ruiter et al., 2020; Hagenauer et al., 2015). Going beyond previous research, the findings reveal a general trend of teachers' positive and negative emotions in the classroom.

8.2.2 Teachers' lesson-specific emotions and work-related and general well-being

The findings of this thesis (see Figure 24) suggest that teachers' lesson-specific emotions link to their work-related well-being and overall satisfaction (general well-being) with their lives. In Study 1, the links between teachers' momentary emotions and their work-related well-being as well as their general life satisfaction were investigated.

Despite the fact that momentary emotional experiences have been naturally seen as an indispensable element of well-being and an influencer in emotions and well-being research, the links between momentary emotional experiences and work-related or general well-being as a cyclical process have not been explicitly explored in educational settings.

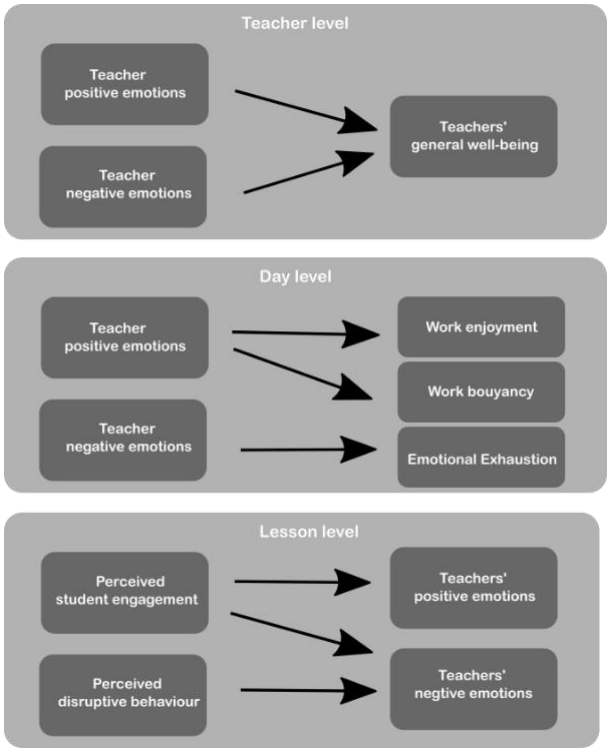
The cyclic process of teachers' emotions and well-being emerged in the research, showing that teachers' momentary emotions were predicted by their evaluation of events in the classroom. In turn, teachers' momentary emotions (i.e., the average positive and negative emotions each day) predicted their daily work-related well-being (emotional evaluation such as work enjoyment and emotional exhaustion) and then further predicted their satisfaction with life at the personal level (i.e., general well-being). However, their momentary emotions in the classroom could relate to how they feel in the morning (in relation to sleep quality especially) and their initial life satisfaction at the personal level. These findings align with previous cross-sectional research that focused on teachers' discrete positive emotions and work-related well-being (Nalipay et al., 2019) and echo daily diary research regarding positive emotions and general life satisfaction in a broader context (Cohn et al., 2009). Going beyond

previous cross-sectional research, the specification of MSEM enables disentangling the findings at three different levels: lessons (situations), days and persons.

Furthermore, in line with the broaden-and-build theory (Fredrickson, 1998, 2004) and the theoretical model of Spilt et al. (2011), the findings of this thesis suggest that higher positive momentary emotional experiences predict a higher level of positive indicators of work-related well-being at the end of the working day, as well as teachers' general well-being later on. Negative momentary emotional experiences, however, link to negative indicators of work-related well-being, especially teachers' daily exhaustion level. Thus, on days when a teacher has experienced a higher level of negative emotions, they feel more exhausted. As discussed in Study 1, the results of this thesis imply two self-perpetuating different pathways or systems of momentary emotional experiences (Garland et al., 2010). Positive emotional experiences could cultivate upward spirals that enhance well-being, health, and fulfilment, reflecting the positive indicators of daily work-related well-being (i.e., work buoyancy and work enjoyment). In this research, negative emotions trigger downward spirals that reflect teachers' exhaustion levels. Although further research is needed regarding the upward spirals of positive emotions and the downward spirals of negative emotions, the findings of this

thesis demonstrate the importance of lesson-specific emotions of teachers to their teaching careers and general lives.

Figure 24 *Teacher emotions, perceived student behaviour, and teacher well-being*



8.2.3 The emotional contagion between teacher and student

In order to fulfil the second aim of this research regarding understanding the emotional contagion and the directionality between teachers' and students' emotions, this research expands previous studies that primarily focused on student-perceived teacher emotions and student emotions to investigate the relationships between teachers' emotions, students' emotions, and students' perceptions of teacher emotions in Study 2. The

findings demonstrate that reciprocal relationships exist between teachers' and students' emotional experiences but do not always happen.

First, in line with previous studies regarding emotional contagion (Becker et al., 2014), the findings indicate that students' perceptions of teachers' momentary emotions link to students' own momentary emotions. Using a daily diary research method (once per day), a previous study found that teachers' boredom is not related to student boredom or students' perceptions of teacher boredom in secondary schools (Tam et al., 2019). Interestingly, using ecological momentary assessment in this thesis (data collected at the end of each lesson), the lack of a significant effect of teachers' self-reported emotions on students' emotions (positive/negative) in the concurrent lessons partly supports previous studies on the relationship between teachers' boredom and students' self-reported boredom. The further findings of the relationships between student-perceived teacher emotions and teacher self-reported emotions suggest that although the relationship is relatively weak, students' perceptions of teachers' emotions were related to teachers' self-reports. This indicates that students 'catch' teachers' positive and negative emotions to some extent from teachers' emotional expressions and displays as described by emotional contagion theory, but a discrepancy exists between students' perceptions and teachers' self-report.

A further inspection of the reciprocal relationship between teacher and student reveals an intriguing pattern of the lagged effect of students' perceptions of teacher emotions, student emotions, and teacher-reported emotions. Previous longitudinal research (Frenzel et al., 2018) shows that group-level students' enjoyment at the beginning of the school year is unrelated to teachers' own enjoyment at midterm. However, when teachers have a higher level of enjoyment at the beginning of the school year, their students have lower enjoyment at midterm (Frenzel et al., 2018). In addition, students' enjoyment seems relatively more stable, while teachers' enjoyment appears relatively less stable (i.e., none-significant autoregressive coefficient). Exploring the reciprocal relationship of teacher emotions and student emotions across lessons, the findings in Study 2 first indicate that a reciprocal relationship exists between student-perceived teacher emotions and students' own emotions. A higher level of students' prior perceptions of teachers' positive emotions in the previous lesson predicted a higher level of positive emotions in the current lesson. In addition, a higher level of prior students' positive emotions in the previous lesson predicted a higher level of student-perceived teacher positive emotions in the current lesson. The same pattern was found regarding negative emotions (i.e., a higher level of student-perceived teacher negative emotions/students' negative emotions in the previous lesson predicted

students' negative emotions/student-perceived teachers' negative emotions in the current lesson).

Moreover, the findings regarding the reciprocal relationships between teachers' and students' self-reported emotions show that emotional contagion (the relationship between student emotions and teacher emotions) mainly happens from teachers to students but not the other way around, especially for positive emotions. A higher level of teachers' positive emotions in the previous lesson predicted students' positive emotions in the current lesson. Thus, it might be that higher teachers' positive emotions could increase students' positive emotions and have the potential to protect them to some extent from experiencing high levels of negative emotions in the classroom. It is encouraging that compared to teachers' negative emotions, teachers' own positive emotions have more potent meanings for students' emotions. Taken together, this indicates the importance of increasing teachers' authentic and clear positive emotional experiences. This might help students' awareness of teachers' positive emotions and further support students' own emotions.

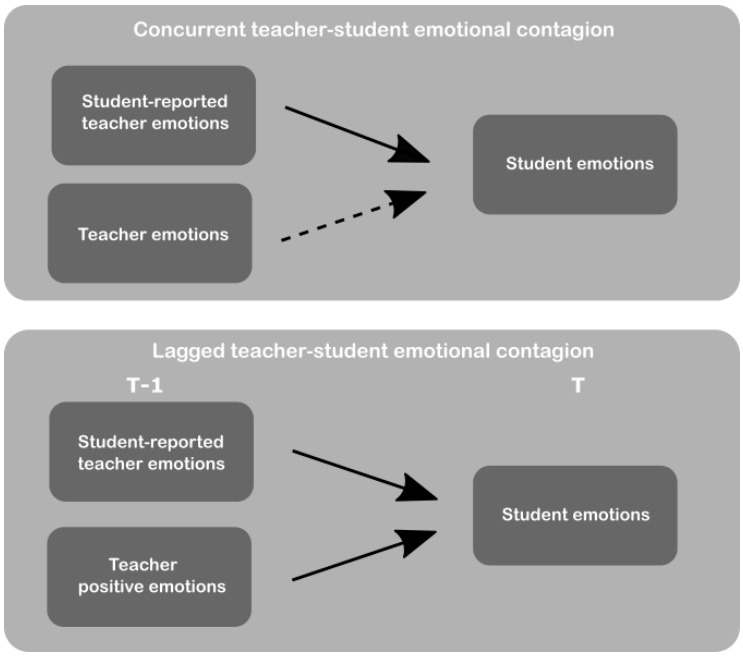
Overall, the findings depict the emotional contagion between teachers and students at two different levels: (1) emotional contagion between teachers and students in the concurrent lesson, and (2) emotional contagion between teachers and students

from one lesson to another (lagged emotional contagion and reciprocal relationships). Figure 25 provides a summary of the findings of emotional contagion of the concurrent emotional contagion and the lagged contagion between teachers and students. In terms of the concurrent emotional contagion between teachers and students, this research found a relationship between student-perceived teachers' emotions and student emotions, but no clear relationship between teacher and student self-reported emotions. However, by investigating the relationship between emotions in the previous and current lessons, this research demonstrates the links between teachers' self-reported positive emotions and students' positive emotions.

In summary, the findings of this thesis address several questions regarding emotional contagion between teachers and students in primary schools. First, the research investigated the mechanism of momentary emotional contagion between homeroom teachers and their students. Second, it addressed the reciprocal relationship considering teacher reports and student reports on emotions and students' perceptions of teachers' emotions. The findings support the importance of students' perceptions of teacher emotions on students' own emotions. Interestingly, although there is an overlap between teachers' self-rated emotions and student-rated teachers' emotions, these ratings are not always congruent. Further research is needed to explore the underlying

factors, such as teachers' emotional display, emotion regulation strategies, and teachers' and students' emotional awareness (Jiang et al., 2016; Keller & Becker, 2021; Matsumoto et al., 2008) that might have an impact on the mechanism of emotional contagion in classroom settings.

Figure 25 *A summary of teacher-student emotional contagion and reciprocal relationships*



8.2.4 Target students and teachers' emotions

The third aim of this thesis is to investigate the dyadic relationship between teachers and individual students in the classrooms. Study 3 addressed this aim by investigating whether teachers react emotionally to target students' engagement in the classrooms differently, mainly if there were differences in emotions depending on whether the teacher was relatively more or less involved with each of these target students.

The findings demonstrate that teachers tend to build up a stronger link with students with whom they were involved relatively more in the past. Unlike previous studies (e.g., de Ruiter et al., 2020, 2021), this research did not use teachers' perceptions of students' prior behaviour or academic performance to select target students, especially students whom teachers perceived had more disruptive behaviour. Instead, target students were selected based on teachers' involvement level (students they paid relatively more or relatively less attention to) in previous lessons. This highlighted teachers' awareness of whom they decided to give relatively more attention to in the class, considering the teacher-student relationship in the context of primary schools in Taiwan. This echoes the previous study that teachers' relationships with individual students could be distinguished by the time devoted to those students (Newberry & Davis, 2008).

Furthermore, previous studies showed that teachers' perceptions of students' disruptive behaviour in the past related to teachers' negative appraisal of the events and their emotional reactions to the events (de Ruiter et al., 2020). Through a different lens, this research found that individual students' current engagement matters, and teachers' investment of time and attention (teacher involvement) may also be decisive. Teachers may underestimate or be unaware of the importance of their involvement with students

to build good relationships. The findings suggest that teachers' involvement level could interact with their perceptions of individual students' engagement during teaching and contribute to accumulating teachers' positive emotional experiences and building up their sense of connection and relatedness among teachers.

8.3 General strengths and limitations

This thesis has some unique strengths. First, it mainly focused on teachers' perspectives but integrated both teachers' and students' reports on their emotions in real-time classrooms. Thus, the findings draw on multidimensional perspectives (multiple reporters and multiple time points), including teachers' and students' self-reports and reports from teachers to students and also the other way around. Second, this research investigated the mechanism of teachers' teaching emotions, from potential factors while working with students to potential outcomes (e.g., overall well-being). This highlights the dynamic characteristics of teachers' emotional experiences and the linking role of momentary emotions in school settings. In addition, it addressed the reciprocal relationships of emotional contagion in the classroom, providing further insights into the directionality between teacher and student emotions in a primary school context.

This research also has three limitations that warrant attention overall. First, the studies consisted of a relatively small sample size of teacher participants. Although the

original sample size planned (30-50) at the highest level was considerably more than the final sample size, access and time challenges due to the pandemic led to a smaller final sample. The relatively small sample size could account for the non-significant findings at the highest level, especially in Study 1, which involves teachers' momentary emotional experiences and their work-related and general well-being. The relatively small sample size also limited further consideration of gender differences (2 male teachers out of 20 in the research). In this thesis, data were analysed using Bayesian estimation, in which parameter estimates with robust credibility intervals could be computed. However, it is suggested that future research include a larger sample to investigate differences between teachers to further generalise the effect of the findings.

Another limitation pertains to the measurement of the current research. Although multiple data sources (including both teacher and student data) were collected, the nature of the reports is still self-reported data. Additionally, teachers' perceptions of students' emotions were not included in this research to lower the burden on the participants. Therefore, this research could only compare students' perceptions with teachers' ratings but not teachers' perceptions with students' ratings. Future studies could include teachers' perceptions of student emotions to explore the relationship between teacher emotions and student emotions further.

Further, since this research is micro-longitudinal and requested participants to repeatedly report several items regarding their emotional experiences in the classroom, it is worth noting the potential for careless responses or response boredom. In this research, the researcher provided training, communicated frequently with teachers and students, and pre-screened all responses to inspect stationary response patterns to mitigate this issue. As this project was conducted in a specific context, primary schools in Taiwan, the findings and conclusions are relatively specific. They may not be able to generalise to all types of contexts. However, this research has the potential to inform policy and educators in the Taiwanese context and provides insights into the theoretical perspectives and empirical studies.

8.4 DIRECTIONS FOR FUTURE RESEARCH

This thesis focused on a set of research aims regarding emotional experiences circumscribed by the challenges in the process and the timeframe of a doctoral project. However, several significant directions for future research emerge from this research. Some directions were mentioned in the limitation section, arising from the research process, limitations, and the findings of this thesis. However, a few other future directions deserve further discussion in this section.

Some interesting themes emerged regarding the specific cultural context of this research. For example, the variability of emotions across lessons is shown to be less fluctuating compared to previous experience sampling research, especially teachers' emotions (Becker et al., 2015; Frenzel et al., 2020; Keller, Chang, et al., 2014). Similarly, teachers' beliefs in harmony correlated with several emotional aspects (e.g., positively correlated with teachers' person-average positive emotions and negatively correlated with negative emotions) of teachers in the correlation analysis (see Study 1). As in different cultural contexts, people may report different degrees of emotion and may have different tendencies in expressing them (Hansen & Mendzheritskaya, 2017). These findings could imply the culture-specific responses of teachers in the current research. Given the relative homogeneity of Taiwanese teachers' momentary emotional experiences and their link to teachers' lives and students' learning, it would be beneficial to compare different cultures using a larger sample size in future research.

From the methodological perspective, future research could go one step further to apply an experience sampling method or integrate other methods in the research in the Taiwanese primary school context (e.g., observations and facial expression detection by AI). The micro-longitudinal design with ecological momentary assessment used in this thesis is a relatively new method applied in the Taiwanese primary school context.

Thus, to lower the interference in the classes, instead of using the experience sampling method, this research collected responses repeatedly at the end of each lesson (based on a set school timetable). Even though this matches the aim and reduces the retrospective bias in the research, it is based on the lesson rather than random moments in lessons. However, this research provides evidence of the feasibility of using the micro-longitudinal method to simultaneously collect teacher and student data after a proper induction or training session in Taiwanese primary schools. This implies that future research could collect the experience sampling data to explore further primary school teachers' and students' emotional experiences in the classroom. Furthermore, future studies could incorporate other measurements, such as observations, to mitigate the drawbacks of self-reported data. However, it should be pointed out that based on the findings of this research and previous studies, self-reporting is an essential source for the exploration of emotional experiences (Pekrun, 2016). Thus, it is suggested that future research could use an ambulatory measurement of objective indicators of teachers' physiological arousal (e.g., electrodermal activity, Paloniemi et al., 2022), stress (e.g., cortisol levels, Jõgi et al., 2022), or heart rate (e.g., increasing heart rate as a control variable) as a complementary to self-report measures.

Reflecting on the theory, it is worth investigating the cyclical process of teachers' situational emotional experiences and their work-related and general well-being in a longer timeframe. This research also addresses the link between teachers' momentary emotional experiences with their daily work-related well-being and general life satisfaction. This research provides the initial investigation of the classroom antecedents (i.e., student behaviour) of teachers' momentary emotional experiences and the cyclical process of teachers' momentary emotional experiences, daily work-related well-being, and general well-being using a micro-longitudinal design in a calendar week. The findings of this thesis support that teachers' situational positive and negative emotions work as two pathways that reflect the relationship between teachers' emotions and their daily work-related well-being (Garland et al., 2010). Nonetheless, the forming process or the offset effect of teachers' emotions might need longer incubation. Future studies could investigate the process during a more extended period or include further follow-up research. For instance, future studies could use a 'burst design' (e.g., Sliwinski, 2008) with another round (or other rounds) of intensive repeated measurement over wider time intervals (e.g., semiannual or annually).

Further, this thesis examined teachers' and students' emotional experiences based on the dimension of valence (positive emotions and negative emotions). As

discrete positive emotions were less distinguished in the previous studies and usually only included high-arousal emotions (e.g., enjoyment), this thesis included different discrete positive and negative emotions and high and low activating emotions in the survey. Future research could examine the functions and effects of different discrete positive emotions. It is also worth exploring the effect of high-activated and low-activated situational emotions based on the four dimensions categorised by valence and activation level (e.g., Pekrun, 2006) in school settings. These investigations could be used to identify the role of different emotions in classroom settings and further help the development of an intervention to support teachers' and students' emotions in the classroom.

8.5 IMPLICATIONS

Based on the theory and previous research, a set of research questions concerning emotional experiences in school settings were examined in the studies of this thesis. In particular, this research focused on a specific context in Taiwan. It has several theoretical and practical implications for the Taiwanese context and other contexts that concern teachers' and students' emotional experiences and the interplay between teachers and students. This section will discuss two types of implications: (1) implications for theory and research and (2) implications for practice and policy.

8.5.1 Implications for theory

Overall, the theoretical contribution of this thesis to the research on teachers' emotional experiences and teacher-student interplay in school settings is fourfold. First, it contributes to the knowledge of the cyclical process of teachers' momentary emotions to work-related and general well-being. In addition, this thesis adds to the understanding of general students' role in teachers' emotional experiences in school settings. Third, it contributes to understanding the emotional contagion between teachers and students in the real-time classroom. Last, this thesis contributes knowledge about the teacher-student dyadic relationship in the real-time classroom.

First, this thesis provides evidence that in the cyclical process of teachers' emotional experiences, negative emotions mainly predict the negative indicators (e.g., exhaustion) of teachers' daily work-related well-being. However, positive emotions predict positive indicators (e.g., work enjoyment, buoyancy) and marginally predict negative indicators of teachers' daily work-related well-being (i.e., emotional exhaustion). This reflects the potential buffering role of positive emotions and expands the broaden-and-build theory and previous research that positive and negative emotions may work differently but cross with each other and shape their mental health and general well-being (Garland et al., 2010). As the results demonstrate, teachers' positive

and negative emotions predict teachers' daily work-related well-being in different ways. Teachers' momentary positive emotions connect to the positive indicators of work-related well-being, and negative emotions link to daily negative work-related well-being. However, both emotions are significantly correlated with teachers' general evaluation. To some extent, this helps explain why, at some points, teachers feel exhausted but happy simultaneously. For teachers, experiencing positive emotions could help build personal resources and skills to deal with the negative events or adversity they experience in the classroom.

Second, the studies presented in this thesis further provide empirical evidence for the importance of student behaviour as antecedents of teachers' emotions in real-time classrooms, which mirrors previous theoretical models (Frenzel, 2014; Spilt et al., 2011). In particular, the findings suggest that in general classrooms, students' engagement (i.e., students' motivational behaviour) may play an important role in positive and negative teacher emotions.

Third, the results in this thesis indicate that emotional contagion may not always happen in school settings, especially the direction from a group of students to a teacher. Additionally, teachers' negative emotions mainly affect students' negative emotions. Altogether, these mirror the previous studies that focused on emotional contagion

(Deng & Hu, 2018; Pinilla et al., 2020), indicating that positive and negative emotional contagion may be based on two different routes. Teachers' positive emotions may be more likely to transmit to students' positive emotions compared to negative emotions. The evidence of the emotional contagion between teachers and students then integrates and underpins the link between the broaden-and-build theory and the research of emotional contagion.

Fourth, this thesis provides evidence of the level of teacher involvement, which plays an important role in student engagement (i.e., motivational behaviour) on teachers' emotions, reflecting on the bond between teachers and students. This echoes and expands the existing theoretical teacher well-being model (Spilt et al., 2011) in two aspects: (1) the crucial role of teachers' mental representation of the teacher-student relationship between perceived students' social-emotional or motivational behaviour and teacher momentary emotions or teacher well-being, (2) the active role of teacher's involvement level in the whole process. As the teacher-student relationship may be more than building up either pure close relationships or conflictual relationships according to students' observable behaviour (e.g., perceived student disruptive behaviour), teachers' conflictual relationships with students do not necessarily lead to a decrease in teachers' positive emotions and close relationships do not necessarily lead

to lower negative emotions (Spilt & Koomen, 2009). Instead, building a relationship with students requires teachers' attention to the need for involvement (Newberry & Davis, 2008; Spilt & Koomen, 2009).

8.5.2 Implications for practice and policy

This thesis focused on teachers' emotional experiences and how they relate to students in school settings to support teachers' well-being at the very beginning, especially in the context of Taiwan. The three studies presented discussed questions regarding teachers (Study 1), then teachers with the whole class of students (Study 2) to teacher-student dyads (Study 3). Overall, this research has several implications for practice and policy.

The findings regarding the link between teachers' lesson-specific emotions and their daily work-related well-being and general well-being underpin one of the significant implications for policy. When teachers have higher positive emotions in class, their daily work-related well-being is higher (enjoyment and buoyancy). When teachers have a higher level of negative emotions in class, they tend to have higher emotional exhaustion that day. Also, teachers' in-class emotions predict their overall life satisfaction. The findings suggest that to build up a positive climate in school settings, understanding the real-time classroom emotions of teachers is essential in fostering teachers' work-related and general well-being in the Taiwanese primary school context.

Notably, a new support centre, ‘Teachers’ Efficacy Augmenting and Coaching Hub (TEACHub)’, has just launched in 2022. It aims to support pre-service and in-service primary and secondary school teachers’ self-efficacy development and mental health (e.g., emotional support). Adding to the need for providing teachers’ skills and mental support outside the classroom context, this research suggests that the momentary emotions of teachers and students in the classrooms should not be disengaged from teachers’ stress and well-being topics.

This study was the first to examine how particular students’ engagement contributes to teachers’ positive and negative emotions in the real-time classroom, taking teachers’ involvement into account. Findings indicate that the more teachers perceived they were involved with the student in class in the past, the stronger the effect of the student’s level of engagement on the teacher’s emotions. Results also indicate that teachers might have a closer or stronger conflictual relationship (or both) with particular students they report paying relatively more attention to in the classroom. Taken together, the findings contribute to our understanding of teacher emotions in the classroom. When students with whom teachers are relatively more involved are actively engaged in class, the teacher tends to have higher levels of positive emotions. These findings have significant implications for understanding the factors in increasing

teachers' positive emotions and decreasing teachers' negative emotions in teacher-student interaction situations, particularly in Taiwanese primary schools. It could be beneficial for schools to support teachers to be aware of their relationship with each student and address the importance of the effort they put in, as the stronger bonds between teachers and students contribute to teachers' positive emotional experiences and benefit students.

The findings in this thesis support that teachers' and students' perceptions matter more to their own emotions, while students' emotions are predicted by their perceptions of their teachers' emotions. An implication that emerges from this is the importance of the awareness of emotions in school settings. Interventions or training programmes for teachers and students that address emotion awareness could help teachers and students identify emotions that emerge during the lesson, support teachers in identifying the antecedents of experienced emotions, and further lead to emotional regulation (Lavoué et al., 2020). Evidence has shown that intervention programmes that guide teachers to simply reflect on their interactions with students and teachers' positive and negative emotions with particular children could improve teacher-student relationships (Spilt et al., 2012).

Furthermore, results regarding the variability of emotions at lesson levels and individual levels across the studies presented in this thesis have an important implication that echoes an issue that has long been discussed. Momentary emotions show that both the lesson and individual level (student and teacher) are essential for emotions, reflecting that teachers' and students' emotions in the classroom are both state-like and trait-like (for example, the intraclass correlation of positive and negative emotions at teacher-level in Study 1 were: 0.59 and 0.56. For students, positive and negative emotions at the student level in Study 2 were 0.47 and 0.40). It is worth noting the cultural context's role in the results. The slightly different results of teacher and student emotional variance across levels could account for the cultural difference regarding emotional expression and social expectations of teachers (Lim, 2016). Studies presented in this thesis in the context of Taiwanese primary schools found a more considerable variance at the individual level (relatively less situation-specific) compared to previous research could reflect the different emotional arousal levels (e.g., value low arousal rather than high arousal emotions) and intensity (e.g., the emotional response is less intense) addressed and experienced by teachers and students in Taiwan. Although more research is needed to examine emotional experiences and the variability across lessons (or situations) in Taiwan, the findings of this thesis imply that it would be

beneficial to consider the different emotional expressions when designing an intervention for teachers and students.

8.6 Concluding remarks

This thesis aimed to investigate teachers' momentary emotions and teacher-student interplay in the Taiwanese context. Based on a quantitative micro-longitudinal design, the data collected for the research were analysed, specifying multilevel structural equation models presented in three manuscripts. Primarily focused on teachers' perspectives of interactions with students in the primary school classroom, this thesis provides novel information on primary school teachers' momentary emotional experiences in the Taiwanese context. Additionally, this thesis provides empirical evidence of the reciprocal relationship between teachers' and students' momentary emotional experiences. Furthermore, the findings revealed the teachers' emotions with individual students' engagement in the classroom, enhancing the understanding of the active role of individual students beyond the scope of perceived student disruptive behaviour and the teacher-student relationship.

The findings of this thesis can lead to a conclusion that the momentary emotional experiences of both teachers and students play a crucial role in understanding the interplay between teachers and students. The results indicated that teachers' work-

related and general well-being could benefit from understanding and improving teachers' momentary emotional experiences in the context of teacher-student interaction in Taiwan. Additionally, while the results describe the critical role of teachers' and students' perceptions in accumulating positive emotions in school settings, the findings also highlighted the active role of teachers in their students' emotions.

Overall, the research addresses the dynamics in the classroom and provides evidence of the critical role of the emotional experiences of teachers and students, albeit the sample size and the specific context limit the generalisability of this research. The approach and the research design cast some light on the theoretical and practical aspects of building positive classrooms and improving teachers' well-being by expanding the knowledge of teachers' momentary emotional experiences. Even though this thesis is mainly based on teachers' perspectives, studying a corresponding perspective from students would be beneficial in understanding of the interplay between teachers and students. Future research is needed on how to effectively support teachers and students in schools via their interactions.

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Appendix A: Pilot studies

The initial design of the research focused on teachers' and students' emotional experiences and teachers' well-being in the context of teacher-student interactions in Taiwanese primary school settings. In 2019, two pilot studies were conducted. The pilot studies took place in New Taipei City and Taipei City in Taiwan. Based on the feedback and outcome of the two pilot studies, the design was modified and the selection of participants in the formal study was formed. For each of the pilot studies, the method, challenges, key findings, and important points are summarised below.

Pilot study 1: A qualitative semi-structured interview

The aim of this step was to understand how teachers and students interact with each other within the specific cultural context in Taiwan. Additionally, teachers and students were asked to indicate their difficulties in understanding questions, especially those related to emotions. The pilot study also tested whether the software works well and whether electronic devices are feasible and easy to use for primary school teachers and students in Taiwan.

A semi-structured interview was used for the first pilot to help us better understand Taiwanese teachers' and students' emotional experiences during lessons and

the interplay between teachers and students. Three primary school teachers (aged 38-50 years old. Teaching experience ranged from 13-29 years) and three primary school Year 3 and Year 4 students (aged 8-10 years old. Two girls and one boy) from different public primary schools were recruited. It was planned that all participants (teachers and children) were first interviewed by the researcher and asked to fill in a simple electronic questionnaire regarding emotional experiences in the classroom using the devices the researcher provided. After using the devices to fill in the checklist, participants were asked for feedback. The audio files were transcribed, and the key findings and take-away points of teacher and student interviews are as below.

Teacher interviews

The semi-structured interview with teachers provided rich information regarding their emotional experiences at different times (e.g., in the morning, during lessons, and at the end of the teaching work) and the in-class interactions with students. The primary questions guiding the teacher interview were: (1) What is the context in public primary schools in Taiwan? (2) Do teachers experience emotional changes in their daily lives, and are there any events related to their emotions? (3) How do teachers evaluate their lives? (4) What role does the interaction between teachers and students play? Interestingly, several themes emerged from the results of the teacher interview.

First, through the semi-structured interview, teachers provided information on subjects that homeroom teachers teach in primary schools (such as Mandarin, Math, and Integrative Activity), which provided useful information for the research design. Second, teachers indicated that their emotions in the morning differed based on the situation they faced, and feelings in the afternoon depended on what happened (e.g., challenging student issues, conflict with children) during the working day. Interestingly, teachers reported that they could feel tired/exhausted but be motivated to engage more. One reason teachers stay in their teaching career is the gratification they derive from students' progress. Third, teachers' common emotions when interacting with children include enjoyment, anger, anxiety, pride, relief, disappointment, and frustration. Fourth, interactions with a particular student could arouse emotions in teachers, such as anxiety. Fifth, teachers tend to disguise their emotions, especially negative ones, in front of children, which could lead to a sense of frustration afterwards. Sixth, students' behaviour and attitude are crucial factors that trigger teachers' emotions. Anger and sadness are usually triggered by students' inappropriate or disrespectful behaviour or lack of involvement in class. In addition, teachers have accumulated anger or negative emotions if some students show low levels of engagement, negative attitudes, or disruptive behaviours repeatedly as time goes by. However, students' engagement in the

class also triggers positive emotions in the teachers (e.g., happiness and enjoyment). The student behaviour teachers mentioned is probably particularly related to students' engagement and how much time teachers spend on one specific child. Seventh, students' achievements and grades affect teachers' goal setting. However, student achievement is not as important a consideration as students' attitudes (e.g., engagement, paying attention and working hard in class) or other issues, such as student health. Eighth, teachers' relationships with their students are important, but the connection between teachers and students may not be built with a specific group of students. Last, teachers may pay relatively more attention to and put relatively more effort into some particular students (e.g., with more explicit behaviour) even though they feel it is unfair to other students. Teachers expressed experiencing stronger feelings when these students make progress.

Overall, teachers have positive attitudes toward using tablets or smartphones (electronic devices) to collect data during research. In addition, they also mentioned that electronic devices may enhance students' motivation. At the end of the interview, teachers were encouraged to provide any feedback on the potential research design and the procedure. Teachers gave feedback and suggestions worth considering in the main research. The first point is that this research method may not be suitable for every

subject matter (e.g., for homeroom teachers, it might not be suitable for a PE class). Second, timing is important. For example, the first week of the semester in primary schools is not a time when it would be practical to start the research. Additionally, if Year Six students are invited as participants, it is important to note that their graduation date is before the end of the school year.

Children's interview

The aims of the children's interview supplemented by the checklist were to understand how students feel about using electronic devices and whether they could understand the description of emotions in the checklist. In addition, another aim of this interview was to understand, in general, what emotions the children experienced when interacting with their homeroom teacher in school.

In this interview (checklist), diverse emotional expressions in Mandarin were provided to children to understand the appropriate wording. The results showed that the most common emotion that Year 3 and Year 4 students experienced was enjoyment. Sometimes, they may be angry, surprised, helpless, relieved, anxious (nervous), fearful, or relaxed. However, it is worth noting that "hope" and "hopeless" are quite abstract concepts for students. They asked about the meaning of these terms. In addition, they tended to use happy and unhappy (valence of emotions) to express and distinguish their

emotions in the interview. According to the interview, they were less likely to experience sadness, shame, guilt, frustration, or pity in school. Children showed differences in emotions such as pride, boredom, hopelessness, and fear.

Intriguingly, students in the interview expressed that they could sense teachers' emotions, such as happiness or anger, especially anger. Two children described the situation when their teacher got angry, and they indicated that teachers' anger was related to student engagement in class, particularly related to some individual students. This is in line with the results of the teachers' interviews. Additionally, students articulated that they believed that teachers got angry when students talked and played in the classroom or did not participate in class (e.g., resting their heads and arms on the desk). Interestingly, students rated teachers' most common negative emotions as anger/fury, fear, guilt, and worry. On the other hand, students perceived the teachers as often experiencing positive emotions, including joy, hope, relief, happiness and relaxation. In general, they did not think their teachers were anxious/nervous, ashamed, or bored in class.

Overall, all children expressed that they liked using tablets to answer the questions on the questionnaire (emotion checklist). During the one-on-one interview, it seemed that children and teachers had no difficulties using tablets to complete the

questionnaire. As the wi-fi connection in schools may not be reliable, the off-line function of the survey software was used. The software worked well and was easy to use for both teachers and students.

Pilot-study 2: An in-class cross-sectional research

The main aim of the second pilot was threefold. The first objective was to understand the feasibility and potential challenges of the research procedure. The second aim was to collect teachers' and students' immediate feedback and response regarding this research. Additionally, this pilot aimed to sharpen the researcher's implementation skills in primary school classrooms.

Convenience sampling was used in this pilot study. First, after receiving the headteacher's permission, a third-year primary school teacher consented to participate in the pilot. The teacher and her Year 3 students were invited in this step because an aim of this pilot study was to ensure that students who are older (including Year 3 students) could understand the wording, and to test the process the researcher intended to use in the main study. Each student received an opt-in consent form and information sheet. Students for whom informed parental consent and assent were to participate in this study. The teacher and students were then instructed to complete a paper-and-pencil questionnaire at the end of a lesson.

A Year 3 teacher (female, aged 46 with 19 years of teaching experience) and 15 students (nine boys and six girls, participation rate 71%) participated. The age range of students was 8 to 10, with a mean age of 8.73 years old (*SD* = 0.59). Teachers' and students' momentary emotional experiences, engagement, and perceptions of teacher support were captured using a paper-and-pencil questionnaire. During the lesson, the teacher also reported a randomly selected target student's engagement. The teacher also answered questions regarding her work-related and general well-being. The data were collected at the end of one lesson in this class.

The main purpose was to understand the procedure in the real-time classroom and observe the teacher and students' responses during the lesson. Although the sample size was small, the data collected was sufficient to help the researche understand the challenges in the procedure and develop the standardised procedure (e.g., the induction) to be used in the main study. Additionally, it provided a glance at momentary emotional experiences and students' engagement in the classroom.

Challenges and considerations

In this pilot study, items for emotions were selected based on the interview (Pilot-study 1). In order to understand how students express their emotions, various emotions were still included in the questionnaire. Some students raised questions about the meaning of

emotions such as hope or shame. This provided valuable feedback indicating that some emotions take work to understand for Year 3 students.

Regarding the procedure, the students' responses to the pilot study made clear to the researcher that having an extensive training session for students was essential. Student participants needed help with reading the student assent forms and needed a longer time for the researcher to explain the procedure during the orientation. Therefore, it was decided that some of the wording would be adjusted, and a more extended induction and training session for students in the main study to explain the content of the assent form and the whole procedure to students would be arranged.

The teacher in the pilot also read the questions in the students' questionnaire after the in-class research to see whether anything (e.g., wording, format) needed to be reconsidered based on students' age. The teacher provided feedback about the questionnaire layout (e.g., the points on the Likert scale) to help students understand the questions more easily.

Summary statistics of lesson-specific data

The student participants' emotional experiences were captured in statements based on previous research (Y.-F. Chang & Cherng, 2017; Pekrun, 2006) and Pilot 1. There were 19 statements (e.g., I felt angry in this lesson), which included common

academic emotions with different wording (in Mandarin). The reliability of students' self-reported positive emotions (Cronbach's α = .83) and negative emotions (Cronbach's α = .89) indicated good internal consistency for both dimensions. Students believed that, like themselves, their teacher had a high level of positive emotions (*M* = 4.38, *SD* = 0.99, e.g., enjoyment, hope, relief, and relaxation) during the class. Internal consistency of students' perceptions of their teachers' positive emotions was 0.88 and was 0.90 for negative emotions.

Student engagement was captured with eight items adapted from Skinner (2009), with four items measuring emotional engagement and four measuring behavioural engagement. The reliability of student engagement was examined (Cronbach's α = 0.93). The Cronbach's α for behavioural and emotional engagement were 0.79 and 0.90.

The teacher was asked to complete a questionnaire regarding her real-time emotions (positive emotions: *M* = 4.0, negative emotions: *M* = 1.2), a target student's engagement (randomly selected, the average score was 5), and general students' engagement (one item scored 4). The teacher was also asked to answer general questions about her work-related well-being (work enjoyment = 5, work buoyancy = 4, work disengagement = 1) and general well-being (life satisfaction, average score = 4).

The teacher provided feedback about the questionnaire and the procedure. The arrangement for investigating emotions during the lesson and the investigation of specific students was then determined.

Moreover, an exploratory investigation of the relationship between students' perceptions of the teacher's emotions and student emotions during the lesson was analysed. Although the sample size was small (n = 15), significant correlations were found between students' perceptions of teacher emotions and students' self-reported emotions. Students' perceptions of their teacher's positive emotions and their self-reported positive emotions ($r = .650$, $p < .01$), and their perceptions of the teacher's negative emotions and their self-reported negative emotions ($r = .895$, $p < .01$) were significantly correlated.

Summary

Overall, the results of the interview showed that homeroom teachers in primary school generally teach Mandarin, math, and Integrative Activities. When interacting with children, they sometimes experience anger, frustration, disappointment, enjoyment, relief, calmness, anxiety, and pride. For primary school teachers in Taiwan, although students' achievement may have an impact on them, students' behaviour and relationships with students are more important. Teachers tend to pay attention to some

particular students in their classrooms because of students' behaviour or attitudes. In addition, students' feedback and engagement in class impact teachers' emotions in a positive way (e.g., enjoyment, pride) or negative way (e.g., anger, disappointment). Children usually have a sense of enjoyment in their daily lives, and they sometimes experience anger, surprise, and relaxation. Children experience fewer negative emotions such as sadness, disappointment, and frustration than positive emotions in class. They tended to perceive their teachers' emotions as either happy or angry. They also identified the situations when they felt their teachers were angry. The children's observation was that teachers often get angry when students were not involved in class, especially related to some particular students in the classroom.

Overall, the pilot provided an opportunity to conduct a survey in class to test the procedure, including the orientation and real-time survey, and to discover potential challenges (e.g., insufficiently clear or detailed orientation session, student age, and the length of the questionnaire). The pilot studies provided feedback that was important for refining the questionnaire and the procedure of the main study.

Appendix B: Information sheet for participants

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Department of Education
15 Norham Gardens, Oxford OX2 6PY
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Teacher Well-being in Primary School

TEACHER INFORMATION SHEET

Ethics Approval Reference: [ED CIA 19 149]

1. ***What is the purpose of this research?***

This project is looking at teacher well-being. We are especially interested in what is the relationship between in-class teacher support, student engagement and the well-being of teachers and students. We are also interested in finding out more about the immediate emotions of teachers in class. In order to do this, we will ask participants to fill in questionnaires during the research period. We already know that the relationship between teachers and students is important to both teachers and students. Unfortunately, we know very little about how teachers and students in class events influence teachers' and children's daily feelings and experiences in school settings. This project will help us to understand the relationship between teacher support, student engagement and well-being. We hope that our findings will allow us to identify ways of helping teachers and students enhance their positive feelings when teaching and learning.

2. ***Why have I been invited to take part?***

You have been invited because you are a teacher in public schools in Taiwan. In other words, you have special interaction experience with children, and your perception is what we care about.

3. ***Do I have to take part?***

No. You can ask questions about the research before deciding whether or not to participate. If you do agree to participate, you may withdraw yourself from the study at any time, without giving a reason, by advising the researchers of this decision.

4. ***What will happen to me if I take part in the research?***

The study will take place for 1-2 weeks between September 2019 and January 2020 (Or February and June 2020). In these weeks, a researcher will visit your class to explain the research to you and your students. You will be asked to fill in a questionnaire about your own experiences and feelings at the beginning and at the end of the research. In addition, you will be asked to fill in an electronic questionnaire to reflect your feelings at the end of each lesson and at the end of the day during the

research period, around 5 minutes per time (around 5 times per day). Pupils will not need to leave their classroom or miss out on lesson time. You are free to follow your normal lesson plan. If you are happy to take part in the research, you will be asked to be visited at least two times at the beginning and at the end of the research.

5. Are there any potential risks in taking part?

Data collection involved self-reported data around teachers' perceptions and students' perceptions of support, engagement and emotions in class collected by questionnaires. To understand your unique subjective experiences, you will be asked to reflect on your perceptions when interacting with some particular students. We would together decide on which students you would report on each lesson in advance. You do not need to make any changes in your teaching practices – just teach and interact with children as you do in ordinary lessons up to now. For your comfort, we will not make it known to the pupils that you are reporting on them, or which one you are reporting on. There is no risk to students, teachers or the schools as a whole are envisioned. If however, you did experience discomfort, we would terminate the research immediately without having any negative consequences.

6. Are there any benefits in taking part?

There will be no direct benefit to you from taking part in this research. However, the process of the study may provide you with further insights into the teaching and learning of teachers and students, especially those related to the teachers' support, student engagement and emotions. Furthermore, by taking part in this study, your school community obtains a chance to share its experiences in an important part of education with a wider audience, including policymakers, education researchers and practitioners.

7. What happens to the data provided?

The information you provide as part of the study is the **research data**. Any research data from which you can be identified (e.g., your name, contact details, date of birth) is known as **personal data**. The research data will be anonymised by replacing all personal data with a simple code before being processed. We will minimise our use of personal data in the study as much as possible. The **research data** will be stored confidentially using password-protected data files. Responses will be anonymised. This means no information will be shared that will allow anyone outside the research team to identify what you and your students have said in the questionnaires. **Personal data** will be stored confidentially in a locked filing cabinet.

The researcher and supervisor will have access to personal and research data. Responsible members of the University of Oxford may be given access to data for monitoring and/or auditing of the study. All research data will be stored for at least 3 years after publication or public release of the work of the research. We may retain and store personal data for an additional period of time as necessary for the purposes of the study and for further research.

8. Will the research be published?

The research will be written up as a thesis. On successful submission of the thesis, it will be deposited both in print and online in the University archives, to facilitate its use in future research. The thesis will be openly accessible. We also aim to publish our findings in scientific journals with open access, but this may be two or three years from the end of the study.

9. Who is organising the research?

The research project is organized by Pei-Hsin Li, a Taiwanese citizen, who is a PhD student at Oxford University. Her research is supervised by Lars-Erik Malmberg, a Professor at the University of Oxford.

10. Who has reviewed this study?

This study has been reviewed by, and received ethics clearance through, the University of Oxford Central University Research Ethics Committee (Reference number: ED CIA 19 149).

11. Who do I contact if I have a concern about the study or I wish to complain?

If you have a concern about any aspect of this study, please speak to the relevant researcher Pei-Hsin Li or her supervisor (please see contact details below), who will do their best to answer your query. The researcher should acknowledge your concern within 10 working days and give you an indication of how they intend to deal with it. If you remain unhappy or wish to make a formal complaint, please contact the relevant chair of the Research Ethics Committee at the University of Oxford who will seek to resolve the matter in a reasonably expeditious manner: *Chair,* ***Social Sciences & Humanities Inter-Divisional Research Ethics Committee****; Email: ethics@socsci.ox.ac.uk; Address: Research Services, University of Oxford, Wellington Square, Oxford OX1 2JD.*

12. Data Protection

The University of Oxford is the data controller with respect to your personal data, and as such will determine how your personal data is used in the study. The University will process your personal data for the purpose of the research outlined above. Research is a task that we perform in the public interest. Further information about your rights with respect to your personal data is available from http://www.admin.ox.ac.uk/councilsec/compliance/gdpr/individualrights/

13. Further Information and Contact Details

If you would like to discuss the research with someone beforehand (or if you have questions afterwards), please contact:

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教師參與者訊息單

國小教師幸福感研究

倫理審查編號: ED-CIA-19-149

親愛的老師您好：

非常感謝您撥冗閱讀這份訊息單。我們是英國牛津大學教育學系的研究團隊，本研究為研究計畫主持人 Lars-Erik Malmberg 所指導的博士生研究論文。我們已取得您學校至校園進行研究的同意。我們誠摯的邀請您參與這項研究計畫。在您決定是否參與之前，請您閱讀關於研究的進行方式與相關資訊。希望您能在瞭解研究規劃後，同意協助我們進行研究。

這個研究的目的為何？

這個研究主要的目的在了解教師幸福感，我們對教師與學生在課堂特定情境的教學與學習參與及學業情緒特別感興趣（計畫名稱：「台灣國小教師幸福感：探究特定情境中教師支持與學生參與的角色」），因此我們會請參與者在研究期間以問卷填答的方式協助我們探索相關議題。雖然我們已經知道師生關係對教師與學生都有重要的影響，但我們對於課堂中教師與學生參與如何影響他們每天的感受所知甚少。這個研究可以幫助我們理解課堂中教師支持與學生參與在師生幸福感上所扮演的角色。我們希望研究的結果在未來可以幫助提升教師教學與學生學習的正向感受。

為什麼邀請我參與研究呢？

我們邀請您參與，因為您是國內公立國小教師的一員。您有您獨特的教學經驗，而您的感受是我們首要關心的。

我一定要參與嗎？

不是的。您在決定前可以詢問關於這個研究的問題後再做決定。如果您同意參與，您仍然有隨時退出研究的權利，且不需要說明原因亦不會有任何不良後果，您只需要告知研究者您的決定即可。

研究參與過程為何？

如果您同意參與研究，這個研究主要會以問卷的方式蒐集資料。研究期程為 108 學年度（2019-2020）之間，研究時間為 1-2 周。在研究期間，研究者會至您的班級向您與學生說明研究流程與蒐集資料。您會需要在研究開始與結束時分別填

寫一份關於個人經驗與感受的問卷。另外，在研究期間，您亦會需要在授課結束前填答簡短的電子問卷，每次填答時間大約五分鐘（一天大約五次）。學生不需要離開教室，也不會影響任何課堂參與，您可以按照您的教學規劃進行教學。如果您願意參與這個研究，研究人員將會在研究期間內至少拜訪您的班級兩次，以說明並瞭解研究的進行。

參與這個研究有任何風險嗎？

研究資料的蒐集主要以問卷方式瞭解教師和學生在教室內教學與學習的經驗與感受。我們也會請您就在課堂中與幾位個別學生的互動進行填答。這個過程主要在了解您於特定情境中的感受，並降低您的填答負擔。您只需要進行原本規劃的課程，按照原先的步調以及與學生互動的方式即可。整體來說，對教師、學生及學校不會造成身體或心理上的不適，也沒有可預期之風險。然若您在研究過程有任何的不適，我們會立即停止研究。請不用擔心，這不會造成任何不良的後果。

參與這個研究有任何益處嗎？

參加這個研究並不會立刻為您帶來直接的益處。但參與研究的過程或許可以提供您進一步思考教師教學與學生學習的機會，特別是特定情境中教師支持、學生參與和教學及學習情緒的關係。此外，藉由參加這個研究，您的學校社群亦可獲得向政策制定者、教育研究者及執行者分享自身經驗的機會。

研究人員會如何處理蒐集到的資料呢?

在研究中蒐集的資料包括兩種。您提供的資料稱為**研究資料**。您提供可以辨認身份的資料稱為**個人資料** (例如：您的姓名、聯繫方式、生日等)。在資料處理前，我們會匿名保密您的個人資料。在研究中，我們也會盡量減少個人資料的蒐集。**研究資料**會遵守保密原則，以經過密碼保護的檔案形式進行儲存。您提供的資料與所有填答都會匿名及保密。我們不會與非團隊成員分享資訊，也不會讓研究團隊以外的人知道您及學生在問卷調查中的任何填答。**個人資料**則會嚴密的儲存於上鎖的櫃子中。

研究者與指導教授將能夠接觸到個人與研究資料。英國牛津大學的重要負責人員也可能會控管與審核研究的資料。所有研究的資料在研究發表後會至少儲存三年以上。若必要的話，我們可能會多保留與儲存個人資料一段時間再加以銷毀，以作為後續研究之用。

這個研究會被發表嗎?

這個研究會被撰寫成一篇博士生的研究論文，在學位論文完成後，文章將會以紙本和線上形式存於牛津大學的資料庫中，以作為未來研究的參考。我們也希望能將這個研究的發現出版於期刊上，但這可能會是在研究完成的 2~3 年之後。

這個研究的研究者是誰?

這個研究是由英國牛津大學教育學系的博士生黎佩欣進行，並由牛津大學的 Lars-Erik Malmberg 教授指導。

這個研究的審查者？

這個研究經過英國牛津大學倫理審查委員會的詳細審核，且已經通過英國牛津大學的倫理審查委員會核准進行 (ED-CIA-19-149)。

如果有任何問題怎麼辦?

如果您對於這個研究有任何疑問或擔憂，請您與研究者或她的指導教授聯繫（請參見研究人員聯絡方式），他們會盡力解答您的任何疑惑。若有任何問題，研究者會在 10 個工作天內說明與答覆處理方式。若您仍有重大疑慮或申訴，請您聯繫牛津大學倫理審查委員會，他們會協助您解決您的問題：*人文與社會科學倫理審查委員會（**Social Sciences & Humanities Inter-Divisional Research Ethics Committee**）; Email: ethics@socsci.ox.ac.uk; 地址: Research Services, University of Oxford, Wellington Square, Oxford OX1 2JD.*

資料保護

英國牛津大學是您個人資料的管理者並決定個人資料於研究中的使用方式。牛津大學會依照前面所述及的研究目的管理您的個人資料。研究的進行乃是基於促進公共利益的目的之上。關於您個人資料權益的進一步資訊可參考：http://www.admin.ox.ac.uk/councilsec/compliance/gdpr/individualrights/.

進一步資訊與研究人員聯繫方式

感謝您的耐心閱讀，您可以依照自己的意願，決定是否同意參與研究。若您想要在決定前先進一步與研究人員討論（或您之後有任何問題），請聯繫：

牛津大學教育學系
博士研究生
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指導教授
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Teacher Well-being in Primary School

INFORMATION SHEET FOR PARENTS / GUARDIANS

Ethics Approval Reference: [ED CIA 19 149]

In partnership with researchers at the University of Oxford, your child's school has agreed to take part in a study investigating the perception of teachers and students' perception about their relationships in class in primary school. We would like to invite your child to be part of this study. We very much hope you would like your child to take part, but before you decide, it is important that you understand why the study is being done and what it will involve.

What are we trying to find out?

This project is looking at teacher and student emotions in class and well-being. We are especially interested in what is the relationship between teacher support, student engagement and the well-being of teachers and students. We already know that the relationship between teachers and students is important for both teachers and students. Unfortunately, we know very little about how teacher and student involvement in class influence teachers' and children's daily feeling and experience in school settings. This project will help us to understand the relationship between teacher support, student engagement and well-being. We hope that our findings will allow us to identify ways of helping teachers and students enhance their positive feelings when teaching and learning.

- **More information about the project can be obtained by contacting the research team (for contact details see the last page).**

Why has my child been invited to take part?

We are inviting your child to take part in it because they are aged between 8 and 12 years, attending primary school at this time.

Does my child have to take part?

No. You can ask questions about the study before deciding whether or not to allow your child to participate. If you do agree to participate, you may withdraw your child and their data from the study at any time, without giving a reason and without penalty, by advising the researchers of this decision.

What will happen if my child takes part?

Participation in the study consists of questionnaires. The study will take place for 1-2 weeks between September 2019 and June 2020. Parents will be asked to fill in a general information sheet on behalf of the child first, and in these weeks a researcher will visit the class of your child. The child will be asked to fill in a questionnaire about their own experiences and feelings at the beginning and at the end of the research. The child will also fill in a short electronic questionnaire on a "Tablet" at the end of each lesson. We will ask the teacher for information on your child, how they get on together, and how learning is going. Teachers will also report on their experiences of teaching the pupils at the end of each lesson. Pupils will not need to leave their classroom or miss out on lesson time. Teachers are free to follow their normal lesson plans. Besides the time we want to request from your child, no risks to students, teachers or the school as a whole are envisioned.

What happens to the data provided?

The study will collect some data. The information you or your child provide as part of the study is the **research data**. Any research data from which you or your child can be identified (e.g., name, birth date), is known as **personal data**. It does not include data where the identity has been removed (anonymous data). We will minimise our use of personal data in the study as much as possible. The **research data** will be stored confidentially using password-protected data files. Responses will be anonymised. This means no information will be shared that will allow anyone outside the research team to identify what your child has said in the questionnaires. **Personal data** will be stored confidentially in a locked filing cabinet.

The researcher and supervisor will have access to personal and research data. Responsible members of the University of Oxford may be given access to data for monitoring and/or auditing of the study. All research data will be stored for at least 3 years after publication or public release of the work of the research. We may retain and store personal data for an additional period of time as necessary for the purposes of the study, and for further research.

The research will be written up in a student thesis. On successful submission of the thesis, it will be deposited both in print and online in the University archives, to facilitate its use in future research. We also aim to publish our findings in scientific journals with open access, but this may be two or three years from the end of the study.

Who is conducting this research?

The research project is organized by Pei-Hsin Li, a Taiwanese citizen, who is a PhD student at Oxford University. Her research is supervised by Lars-Erik Malmberg, a Professor at the University of Oxford. This study has been reviewed by, and received ethics clearance through, the University of Oxford's Central University Research Ethics Committee [ED CIA 19 149].

What if there is a problem?

If you have a concern about any aspect of this project, please speak to the relevant researcher Pei-Hsin Li or her supervisor (please see contact details below), who all will do his/her best to answer your query. The researcher should acknowledge your concern within 10 working days and give you an indication of how he/she intends to deal with it. If you remain unhappy or wish to make a formal complaint, please contact the Chair of the Research Ethics Committee at the University of Oxford who will seek to resolve the matter in a reasonably expeditious manner: *Chair, **Social Sciences & Humanities Inter-Divisional Research Ethics Committee**; Email: ethics@socsci.ox.ac.uk; Address: Research Services, University of Oxford, Wellington Square, Oxford OX1 2JD.*

Data Protection

The University of Oxford is the data controller with respect to your child's personal data, and as such will determine how your child's personal data is used in the study. The University will process your child's personal data for the purpose of the research outlined above. Research is a task that we perform in the public interest. Further information about your rights with respect to your child's personal data is available from http://www.admin.ox.ac.uk/councilsec/compliance/gdpr/individualrights/.

What should I do next?

Please fill in the enclosed form and return it to your child's classroom teacher if you would like your child to take part in this study. If you prefer that I fill out this form for you then please let me know. I will then fill out the form according to what you tell me. Please remember that you

may withdraw your child at any time, without penalty and without giving a reason, by notifying the researcher. If you would like to discuss the research with someone beforehand (or if you have questions afterwards), please contact:

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兒童家長/監護人訊息單

國小教師幸福感研究

倫理審查核准編號：ED-CIA-19-149

親愛的家長您好：

非常感謝您撥冗閱讀這份訊息單。我們是英國牛津大學教育學系的研究團隊，本研究為研究計畫主持人 Lars-Erik Malmberg 所指導的博士生研究論文。我們已取得您孩子就讀的學校對本研究團隊至校園進行研究的同意。我們誠摯的邀請您的孩子參與這項研究計畫。在您決定是否參與之前，請您閱讀關於研究的進行方式與相關資訊。希望您能在瞭解研究規劃後，同意協助我們進行研究。

這個研究的目的為何?

這個研究主要的目的在了解教師與學生在教室中即時的教學/學習情緒與幸福感（研究名稱：「台灣國小教師幸福感：探究特定情境中教師支持與學生參與的角色」)。這個研究特別希望了解教師支持、學生參與，以及師生幸福感間的關係。雖然我們已經知道師生關係對教師與學生都有重要的影響，但我們對於課堂中教師與學生參與如何影響他們每天的感受所知甚少。這個研究可以幫助我們理解課堂中教師支持與學生參與在師生幸福感上所扮演的角色。我們希望研究的結果在未來可以幫助提升教師教學與學生學習的正向感受 (若想獲得更多資訊，可以聯繫研究團隊，研究聯絡方式如附)。

為什麼邀請我的孩子參與研究呢?

我們邀請您的孩子參與，因為您孩子的年齡符合這個研究的規劃（8-12 歲），且目前正在國內的公立國小就讀中。

我的孩子一定要參與嗎?

不是的。您在決定前可以詢問關於這個研究的問題後再做決定。如果您同意您的孩子參與，您仍然有隨時退出研究的權利，且不需要說明原因亦不會有任何不良後果，您只需要告知研究者您的決定即可。

研究參與過程為何?

如果您同意孩子參與研究，這個研究主要會以問卷的方式蒐集資料。研究會於108學年度進行，研究時間為1-2周。首先，父母/監護人會需要代表孩子填寫一份基本資料表。在研究期間，研究者會與教師討論後，到您孩子的班級進行說明與蒐集資料。您的孩子會在研究開始與結束時分別填寫一份關於他們個人經驗與感受的問卷。另外，在研究期間，孩子們亦會在每次導師課堂結束前與老師一起填答簡短的電子問卷。學生不需要離開教室，也不會影響任何課堂參與，教師的正常教學規劃亦不受影響。除了孩子需要填寫問卷外，對學生、教師以及學校整體並沒有可預見的危險，也不會造成孩子身體或心理上的傷害或不適。

研究人員會如何處理蒐集到的資料呢?

在研究中蒐集的資料包括兩種。您或您孩子提供的資料稱為**研究資料**。您或您孩子提供可以辨認身份的資料稱為**個人資料**，個人資料並不包括經過匿名處理的資料形式。我們在研究中會盡量減少個人資料的蒐集。**研究資料**會遵守保密原則，以經過密碼保護的檔案形式進行儲存。<u>您孩子提供的資料與所有填答都會匿名及保密</u>。我們不會任意分享資訊，也不會讓研究團隊以外的人知道您孩子在問卷調查中的任何填答。研究相關的**個人資料**則會嚴密的儲存於上鎖的櫃子中。

研究者與指導教授將能夠接觸到個人與研究資料。英國牛津大學的重要負責人員也可能會控管與審核研究的資料。在研究發表後，所有研究的資料會至少儲存三年以上。若必要的話，我們可能會多保留與儲存個人資料一段時間再加以銷毀，以作為此研究與後續研究之用。

這個研究會被撰寫成一篇博士生的研究論文，在學位論文完成後，文章將會以紙本和線上形式存於牛津大學的資料庫中，以作為未來研究的參考。我們也希望能將這個研究的發現出版於期刊上，但這可能會是在研究完成的2~3年之後。

這個研究的研究者是誰?

這個研究是由英國牛津大學教育學系的博士生黎佩欣進行，並由Lars-Erik Malmberg教授指導。這個研究已經通過英國牛津大學的倫理審查委員會核准（ED-CIA-19-149）。

如果有任何問題怎麼辦?

如果您對於這個研究有任何疑問或擔憂，請您與研究者黎佩欣或她的指導教授聯

繫（請參見研究人員聯絡方式），他們會盡力解答您的任何疑惑。若有任何問題，研究者也會在 10 個工作天內說明與答覆。若您仍有重大疑慮或申訴，請您聯繫牛津大學倫理審查委員會，他們會協助您解決您的問題：*人文與社會科學倫理審查委員會（**Social Sciences & Humanities Inter-Divisional Research Ethics Committee**）; Email: ethics@socsci.ox.ac.uk; 地址: Research Services, University of Oxford, Wellington Square, Oxford OX1 2JD.*

資料保護

英國牛津大學是您孩子個人資料的管理者並決定個人資料於研究中的使用方式。牛津大學會依照前面所述及的研究目的管理您孩子的個人資料。研究的進行乃是基於促進公共利益的目的之上。關於您孩童個人資料權益的進一步資訊可參考：http://www.admin.ox.ac.uk/councilsec/ compliance/gdpr/individualrights/.

下一步是什麼呢?

感謝您的耐心閱讀，您可以依照自己的意願，決定是否同意孩子參與研究。無論您是否願意您的孩子參與這個研究，請您完成隨訊息單附上的同意書，並交還協助團隊的班級導師。若您同意讓孩子參與，我們也會進一步詢問孩子的意願，尊重孩子的感受。如果您希望研究者代為填寫此表單，再請您聯繫研究者，研究者將依照您的意願填寫。請不用擔心，若有需要，您的孩子仍然可以隨時退出研究，不需要任何原因也不會有任何不良後果。如果您需要先與研究者討論 (或您之後有任何問題)，請聯繫：

牛津大學教育學系
博士研究生
黎佩欣
地址：15 Norham Gardens
Oxford, OX2 6PY, UK
電話：(+886)911847986
信箱：pei-hsin.li@education.ox.ac.uk

牛津大學教育學系
指導教授
Lars-Erik Malmberg
地址：15 Norham Gardens
Oxford, OX2 6PY, UK
電話：(+44) 01865-274047
信箱：lars-erik.malmberg@education.ox.ac.uk

Information Sheet for Children

University of Oxford
Department of Education
15 Norham Gardens, Oxford OX2 6PY
Tel: +44 (0)1865 274027

Teacher Well-being in Primary School

STUDENT INFORMATION SHEET

Ethics Approval Reference: [ED CIA 19 149]

My name is Pei-Hsin Li, and I work on a project that is supervised by the University of Oxford, United Kingdom. We are doing some research and would like you to join in. Research is a way we try to find out the answers to questions. We are interested in what you think about your learning at school. Do not worry. There is no chance you can make a mistake because there are no right or wrong answers, only different ones. You can talk to your family, friends, your teacher or the researchers if you want to before you agree to join in.

Why have I been asked?

We are asking you if you would like to take part because we are interested in the opinions and experiences of all students in primary schools. Since you are between 8 and 12 years old, we also would like to invite you to take part in this study. Your parent/carer has said it is OK for you to join in.

Do I have to join in?

No, you don't have to if you don't want to! You can ask questions before choosing whether you want to join in. You can change your mind at any time by telling the researcher or your parent/carer. You don't have to say why. If you decide to stop, no one will be upset with you.

What will happen?

From the beginning of September until the end of January / (or February to June), I will come into lessons for 1-2 weeks at some time. I will give you a questionnaire to fill in. At the end of each lesson, we will ask you to complete a short questionnaire about that lesson on a Tablet. Your teacher will run normal lessons. You will study in the same way as you usually do. We have also asked the teacher to tell us about her/his thoughts about the lesson and how he/she has helped you learn new things.

Will anything about the research upset me?

Questions being asked are simple questions about your life in school, such as your feelings about learning with your teacher in class. Only the research team will go through your answer without telling anyone. Thus, your teacher or head teacher will not know your answer.

Will joining in help me?

We hope that this study will help other pupils and their teachers in the future.

Will anyone else know I'm doing this?

The people in our research team will know you are taking part. No one will know that you have helped us with this research - unless, of course, you tell them yourself!

What happens to what the researchers find out?

When we collect information from you, we will keep it in a safe place and only the people doing the research, or helping with the research, can look at it. We will use the information to better understand how students interact with their teachers and how they feel about their learning.

Is this study OK to do?

Before any research involving people happens it has to be checked by a group of people known as a Research Ethics Committee to make sure that it is fair. This study has been checked by the Ethics Committee at the University of Oxford.

What if there is a problem or something goes wrong?

If you are not happy because of something that happened in the study, please talk to your parent/carer who will let the researcher know.

Thank you for reading – please ask us any questions.



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Department of Education
15 Norham Gardens, Oxford OX2 6PY
Tel: +44 (0)1865 274027

兒童參與研究說明

國小教師幸福感研究

倫理審查核准編號：ED-CIA-19-149

你們好， 我的名字是黎佩欣， 我正在進行一個由英國牛津大學教授所指導的研究。 我們希望邀請你一起參與這個研究。「 研究 」 是我們用來找出問題答案的方法， 而我們好奇你對於在學校學習的想法。

研究的答案沒有對或錯， 請不用擔心你的任何回答。 在你決定是否參與前， 你可以與家人、 朋友或研究者討論， 以及閱讀以下的說明。

為什麼邀我參與呢？

我們邀請你參與， 因為我們對於國小學生的學習感受有興趣。 因此我們邀請你參與這個研究， 你的父母/照顧者說你可以參與。

我一定要參加嗎？

不是的。 如果你不願意， 你可以不用參與！ 你可以在決定要不要參與前問你想問的問題。 如果你在研究中途不想再參與， 你也可以告訴研究者或你的父母。 你不需要說明原因， 也不會有人因此對你生氣。

接下來會發生什麼呢？

在這個學期中， 會有 1-2 周的時間裡， 我會到你的班級去， 跟你們說明研究的進行方式， 並給你問卷， 請你用平板填寫， 而你的老師會照常上課， 你只需要照平常的方式學習就好。

研究中會有讓我不開心的事嗎？

你不需要擔心， 我們問你的問題都是與你在學校中的學習生活有關的一些簡單問題， 例如： 你對於與老師在班級中學習的感受。 而且除了研究人員外， 不會有人知道你的回答。 因此， 你的老師或校長都不會知道你的回答。

參加研究會幫我什麼？

我們希望這個研究可以在未來幫助學生的學習。

會有人知道我參加這個研究嗎？

研究人員會知道你參加研究， 但不會有其他人知道你協助我們進行這個研究。 除非你自己告訴其他人！

我可以放心參加這個研究嗎？

在任何有關人的研究開始之前都會有一群屬於「 研究倫理審查委員會 」 的人負責確認研究是否適合進行。 這個研究已經通過英國牛津大學研究倫理審查委員會的核准， 因此你可以放心參與。

如果我遇到問題怎麼辦？

如果你因為研究中的事物感到不開心或有任何問題，
請你跟你的父母/照顧者說， 他們會讓研究者知道。

謝謝你的閱讀， 如果有任何問題可以向研究者提問



Appendix C: Consent form for participants

University of Oxford
Department of Education
15 Norham Gardens, Oxford OX2 6PY
Tel: +44 (0)1865 274027

Teacher Well-being in Primary School

Teacher Consent Form

CUREC Approval Reference: ED-CIA-19-149

Purpose of Study: This study is about how teachers' and children's perceptions of teaching and learning and how this connects to other factors such as emotions and well-being. We know that the teacher-student relationship is important for both teachers and children. Here, we want to focus on teachers and students' experiences in Taiwan of those teachers and children in public primary schools.

		Please initial each box
1	I confirm that I have read and understand the information sheet version, dated 4 October 2019 for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily.	☐
2	I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason, and without penalty.	☐
3	I understand that research data collected during the study may be looked at by designated individuals from the University of Oxford where it is relevant to my taking part in this study. I give permission for these individuals to access my data.	☐
4	I understand that this project has been reviewed by, and received ethics clearance through, the University of Oxford Central University Research Ethics Committee.	☐
5	I understand who will have access to the personal data provided, how the data will be stored and what will happen to the data at the end of the project.	☐
6	I understand how this research will be written up and published.	☐
7	I understand how to raise a concern or make a complaint.	☐
8	I give permission to be quoted directly in the research publication against my name..	☐
9	I agree to take part in the above study.	☐
10	I agree for my personal data to be kept in a secure database for the purpose of contacting me about future studies.	☐

_____	dd / mm / yyyy	_____
Name of Participant	Date	Signature

_____	dd / mm / yyyy	_____
Name of person taking consent	Date	Signature

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Department of Education
15 Norham Gardens, Oxford OX2 6PY
Tel: +44 (0)1865 274027

國小教師幸福感研究教師參與者同意書

倫理審查編號：ED-CIA-19-149

研究目的：這個研究旨在了解教師與學生在教學與學習時的感受，以及這些感受如何與其他因素(例如：學習情緒和幸福感)相關聯。我們瞭解教師與學生間的關係非常重要，在這個研究中我們會聚焦在台灣公立國小教師與學生的經驗上。

		請勾選
1	我確認我已閱讀並瞭解上述研究的相關資訊(資訊單第三版，2019年10月4日)。而且我有機會評估資訊、詢問問題並獲得解答。	☐
2	我了解我的參與是自願性質的，而且我可以在任何時候退出研究而不需要提供任何原因，也不會有任何不良後果。	☐
3	我了解研究資料可能會受到與此研究有關的牛津大學審查團隊成員的監督。我同意這些團隊的成員能檢視我的資料。	☐
4	我了解這個研究乃經由英國牛津大學倫理審查委員會審查通過。	☐
5	我了解有哪些人可以接觸我所提供的個人資料、資料會如何儲存，以及研究結束後資料的處理方式。	☐
6	我了解這個研究將會被撰寫成文章並發表。	☐
7	我了解提出疑慮或申訴的管道。	☐
8	我同意在研究發表中匿名引用我所說的話。	☐
9	我同意參與上述研究。	☐
10	我同意將個人資料保存於安全的地方以作為未來聯繫之用。	☐

參與者姓名：_____ **日期：**_____

簽　　名：_____

研究人員姓名：_____ **日期：**_____

簽　　名：_____

Parent/Guardian Consent Form

University of Oxford
Department of Education
15 Norham Gardens, Oxford OX2 6PY
Tel: +44 (0)1865 274027

Teacher Well-being in Primary School

PARENT/GUARDIAN CONSENT FORM

CUREC Approval Reference: ED-CIA-19-149

- Your child's school has agreed to take part in a study run by Oxford University looking at teachers' and children's perception of teacher's teaching and their feelings about learning.
- If your child takes part, please help them to fill in the general information sheet. A researcher would come and visit them at school and explain the research and tell them what they could do to help the researcher, including filling in questionnaires at some specific time.

If you are happy for your child to take part, please fill in the form below and return it to your child's class teacher as soon as possible.

- To find out more about the study, please read the attached information sheet. You can also e-mail us at <pei-hsin.li@education.ox.ac.uk>, or call Pei-Hsin Li on 0911847986 if you have any questions.

- - - -

I give permission for my child to take part in the above study Yes ☐ No ☐

Name of parent/guardian: _____

Signature: _____ **Date:** _____

Name of researcher: _____

Signature: _____ **Date:** _____

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Department of Education
15 Norham Gardens, Oxford OX2 6PY
Tel: +44 (0)1865 274027

家長/監護人同意書

國小教師幸福感研究

倫理審查核准編號：ED-CIA-19-149

- 您孩子就讀的學校同意參與由英國牛津大學監督下進行的教師教學與兒童學習感受的研究。
- 如果您同意您的孩子參與此研究，請幫助他們填寫基本資料單。研究者會再到您孩子的班級向他們說明這個研究，並且解釋他們可以如何協助這個研究的進行（例如：在特定時間填寫問卷）。
- **如果您願意讓您的孩子參與研究，請填寫下面的同意表單，並盡快交還給班級導師。**
- 詳細研究資訊可參考所附的研究訊息單，您也可以寄信至研究者信箱：pei-hsin.li@education.ox.ac.uk，或致電：0911847986 詢問研究相關訊息。

孩子姓名：_____

就讀學校：_____

我已經閱讀並了解上述研究的資訊，並有機會詢問研究問題或與研究者討論。我了解這個研究已經通過英國牛津大學倫理審查委員會的核准。我也了解能夠接觸資料的相關人員有哪些，研究資料會如何儲存以及研究結束後資料的處理方式。我了解參與這個研究是自願的，且我和我的孩子可以隨時退出研究，不需要給予任何理由，也不會因此影響到孩子的任何權益。我也了解提出疑問的方法。

我同意我的孩子參與上述研究 是 ☐ 否 ☐

家長/監護人姓名：_____

簽名：_____ **日期：**_____

研究者姓名：黎佩欣

簽名：_____ **日期：**_____

Assent Form for Children

University of Oxford

Department of Education

15 Norham Gardens, Oxford OX2 6PY

Tel: +44 (0)1865 274027

Teacher Well-being in Primary School

ASSENT FORM

Please (or if unable, parent/researcher/teacher on their behalf) circle all you agree with:

Has somebody else explained this project to you?	Yes/No
Do you understand what this project is about?	Yes/No
Have you asked all the questions you want?	Yes/No
Have you had your questions answered in a way you understand?	Yes/No
Do you understand it's OK to stop taking part at any time?	Yes/No
Are you happy to take part?	Yes/No

If <u>any</u> answers are "no" or you don't want to take part, that's OK! No one will be cross with you.

If you <u>do</u> want to take part, please write your name below

Your name _____

Date _____

The researcher who explained this project to you needs to sign too:

Print Name _____

Sign _____

Date _____

Thank you!

University of Oxford
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15 Norham Gardens, Oxford OX2 6PY
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兒童同意書

國小教師幸福感研究

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Appendix D: Study measures

Level	Measures	number	Items /Example items (English)	Items/Example (Mandarin)
Teacher ratings				
Lesson	Emotions (self-reported)	8	*In this lesson,* • I felt enjoyment • I was proud of myself • I felt relaxed • I felt calm • I felt angry • I felt nervous • I was bored • I was disappointed	*在這堂課中，我覺得…* • 開心 • 以自己為榮 • 放鬆 • 平靜 • 生氣 • 緊張 • 無聊 • 失望
	Perceived student engagement 1. Overall students 2. Target students	 1 8	 • To what extent did students engage in this lesson? *In this lesson, this student…* • participated in discussion • worked as hard as he/she can • did more than required • listened carefully • was enthusiastic • appeared involved when working on classwork • seemed to feel good • seemed interested	 • 整體來說，我覺得這堂課學生的參與度? 這堂課中，學生(A) • 參與討論 • 盡他最大努力學習 • 做的比被要求的更多 • 仔細聆聽 • 是熱衷的 • 表現出投入課堂活動的樣子 • 看起來感到愉快 • 看起來感到有興趣
	Perceived student disruptive behaviour	3	*In this lesson, to what extent did student……* • disturb the instruction • chatter loudly	*在這堂課中，有多少學生…* • 打斷授課

Level	Measures	number	Items /Example items (English)	Items/Example (Mandarin)
			• fool around	• 大聲聊天 • 胡鬧
Day	Morning well-being	2	• Did you sleep well last night? • I felt tired this morning when I had to face another day at work	• 請問您昨天晚上睡得好嗎? • 早晨醒來，想到必須面對另一天的工作，我就覺得好累
	End-of-working well-being (example items)[a] 1. Work enjoyment 2. Work buoyancy 3. Work disengagement 4. Work exhaustion	 4 4 3 8	*Today, ……* • I enjoyed my work" • I think I was good at dealing with work pressures • I've pretty much given up being involved in things at work • I feel emotionally drained from my work	今天 • 我享受我的工作 • 我有妥善處理壓力 • 我幾乎放棄對工作投入心力 • 我感到精疲力竭
Individual	General well-being (Life satisfaction)	5	• In most ways my life is close to my ideal • The conditions of my life are excellent • I am satisfied with my life • So far, I have gotten the important things I want in life • If I could live my life over, I would change almost nothing	• 大致上，我目前的生活跟我理想的生活狀態相當接近 • 我的生活狀態非常理想 • 我對生活感到滿意 • 到目前為止，我能夠在生活中獲得我所想要的事物 • 如果生活可以重頭來過，我不會做大幅度的改變
	Harmony belief	9	• I believe that people should have self-restraint. • We should accept personal costs if it keeps the group happy. • We should try to preserve the dignity of others in interpersonal interactions. • We should keep harmony with others at all times in interpersonal interactions. • We should be tolerant of others in interpersonal interactions.	• 我相信人要自我約束 • 我們要逆來順受，以維持人際和諧 • 在人際交往中，我們要特別留意給人面子 • 在人際交往中，我們要隨時注意保持和諧 • 與人相處時，我們要包容別人 • 人際互動時，我們要遵守社會規範 • 人際互動時，我們要秉持中庸之道 • 與人相處，要進退得宜

Level	Measures	number	Items /Example items (English)	Items/Example (Mandarin)
			• We should respect the standards of our society in interpersonal interactions. • We should be moderate and compromise in interpersonal interactions. • We should behave properly in interpersonal interactions. • For the sake of group goals, we should sacrifice ourselves for the greater good.	• 為了團體的目標，我們要犧牲小我，完成大我
	Teacher-student relationship 1. Conflict	15 7	• This child and I always seem to be struggling with each other • This child easily becomes angry with me • This child remains angry or is resistant after being disciplined • Dealing with this child drains my energy • When this child is in a bad mood, I know we're in for a long and difficult day • This child's feelings toward me can be unpredictable or can change suddenly • This child is sneaky or manipulative with me	• 我與這個孩子似乎總是疲於應付對方 • 這個孩子很容易對我生氣 • 這個孩子在被管教之後，依然會繼續生氣或抵抗 • 處理應付這個孩子耗盡我的精力 • 當這個孩子心情不好時，我知道我們進入漫長且困難的一天 • 這個孩子對我的感覺是無法預測或是會突然改變的 • 這個孩子會背著我鬼祟行事或巧妙操控我

Level	Measures	number	Items /Example items (English)	Items/Example (Mandarin)
	2. Closeness	8	• I share an affectionate, warm relationship with this child • If upset, this child will seek comfort from me • This child is uncomfortable with physical affection or touch from me • This child values his/her relationship with me • When I praise this child, he/she beams with pride. • This child spontaneously shares information about himself/herself • It is easy to be in tune with what this child is feeling. • This child openly shares his/her feelings and experiences with me.	• 我與這個孩子分享一種關懷、溫暖的關係 • 假如難過時，這個孩子會向我尋求慰藉 • 這個孩子對於我在肢體上的關愛或碰觸感到不舒服 • 這個孩子重視他(她)和我的關係 • 當我讚美這個孩子時，他(她)會流露出自豪的笑容 • 這個孩子會主動自發地與我分享關於他(她)自己的感覺 • 這個孩子會主動自發地與我分享關於他(她)自己的感覺 • 這個孩子坦然的與我分享他(她)的感覺和經驗
Student ratings				
Lesson	Emotions 1. Self-reported emotions	8	*In this lesson, ….* • I felt enjoyment • I was proud of myself • I felt relaxed • I felt calm • I felt angry • I felt nervous • I was bored • I was disappointed	*在這堂課中，我覺得…* • 開心 • 以自己為榮 • 放鬆 • 平靜 • 生氣 • 緊張 • 無聊 • 失望

Level	Measures	number	Items /Example items (English)	Items/Example (Mandarin)
	2. Perceived teacher emotions	8	*In this lesson, my teacher……* • felt enjoyment • was proud of themselves • was relaxed • was calm • was angry • was nervous • was bored • was disappointed	在這堂課中，我的老師是…… • 開心的 • 以他自己為榮的 • 放鬆的 • 平靜的 • 生氣的 • 緊張的 • 感到無聊的 • 失望的

Note: [a] Only example items were provided due to the consideration of copyright.

Appendix E: Reliability of measurements (Internal consistency)

Level	Number of items	Cronbach's alpha / McDonald's omega		
		Individual	Day/Student	Lesson
Teacher reports				
Life Satisfaction (Pre/Post)	5	0.94(0.95) /0.93(0.94)	-	-
Harmony Belief	9	0.89/0.86	-	-
Teacher-student relationship				
Conflict	7	0.93/0.93	-	-
Closeness	8	0.87/0.88	-	-
End-of-working well-being				
Work enjoyment	4	0.97/0/99	0.94/0.69	-
Work buoyancy	4	0.96/0.98	0.87/0.65	-
Work disengagement	3	0.85/0.89	0.75/0.58	-
Emotional exhaustion	8	0.95/0.96	0.91/0.83	-
Academic Emotions				
Positive Emotions	4	0.85/0.88	0.77/0.79	0.76/0.59
Negative Emotions	4	0.87/0.92	0.82/0.84	0.82/0.67
Perceived Student disruptive behaviour	3	0.87/0.89	0.87/0.77	0.84/0/66
Perceived target student engagement				
Behavioural	4	0.96/0.96	0.95/0.96	0.90/0.84
Emotional	4	0.99/0.99	0.99/1.00	0.95/0.89
Student reports				
Student emotions				
Positive	4	0.74/0.78	-	0.68/0.61
Negative	4	0.86/0.91	-	0.75/0.63
Perceived teacher emotions				
Positive	4	0.87/0.80	-	0.69/0.56
Negative	4	0.86/0.93	-	0.81/0.72

Appendix F: Construct validity of all measurements

Measurements	Number of items		(M)CFA	
		Model levels	Model fit (PPP)	Factor loadings
Teacher reports				
Life Satisfaction (Pre/Post)	5	1	0.361/0.095	0.79-0.95/ 0.67-0.94
Harmony Belief	9	1	0.673	0.33-0.86
Teacher-student relationship				
Conflict	7	1	0.356	0.56-0.93
Closeness	8	1	0.231	0.51-0.83
End-of-working well-being				
Work enjoyment	4	2	0.476	0.33-0.99
Work buoyancy	4	2	0.148	0.50-0.97
Work disengagement	3	2	0.111	0.50-0.95
Emotional exhaustion[1]	8	2	0.112	0.45-0.93
Academic Emotions				
Positive Emotions	4	3	0.329	0.34-0.96
Negative Emotions	4	3	0.248	0.44-0.97
Perceived Student disruptive behaviour	3	3	0.453	0.51-0.89
Perceived target student engagement				
Behavioural	4	3	0.157	0.62-0.99
Emotional	4	3	0.420	0.78-1.00
Student reports				
Student positive emotions	4	2	0.202	0.35-0.92
Student negative emotions	4	2	0.425	0.39-0.99
Perceived teacher positive emotions	4	2	0.345	0.33-0.93
Perceived teacher negative emotions	4	2	0.372	0.58-0.97

Note: Model fits (PPP>0.05), PSR (1.05), and factor loadings are the main indicators for testing the models of Bayesian confirmatory factor analysis in this thesis. Plots such as autocorrelation plots and trace plots were also used to examine each parameter in the models. All models converge well. In some models, a high degree of autocorrelations was observed on several parameters, specified thinning interval were then used for this situation to re-examine the autocorrelations and the results. However, analyses presented in this thesis were the results without thinning due to the consideration of efficiency and accurate parameter estimates issues discussed in the previous research (Link & Eaton, 2012).

[1] One item in the Emotional Exhaustion scale did not fit the general factor with other items well but was possible to specify as a one-indicator-construct at the within-level. Here the factor loadings of the general factor in the model were reported.

Appendix G: Data quality control

The present research collected data from multiple informants in each lesson using teachers' and students' self-reports, student reports of teachers, and teacher reports of students. The data cleaning and quality control were performed following the data collection process.

First, data lines were disregarded if the data could not be linked to participants due to the missing or mismatched participant login IDs (12 occurrences, 0.3%). If participants had duplicated data of the same time duration (if both time points were validated, one of the time points was randomly removed) or if the time stamp was inconsistent with the lesson time of other participants in the same class, the data were disregarded (102 occurrences). Thus, 114 time points (2.8% of raw data) were removed from students' lesson-specific data.

All teachers' responses could be identified. Data was disregarded if teacher participants had duplicated data for the same time point or if the time stamp was identified as inconsistent with the lesson time of students (n = 14, 5.3%).

The student and teacher data were then screened again. Two students' reports were not included in the main analysis because less than half of their lesson responses were valid, and the remaining responses were the same value in their lesson reports.

Different datasets were merged according to the research questions. Across all lesson-specific teacher and student items, missing data accounted for 0% to 6%. Study 1 merged teachers' data at three different levels (lesson, day, and teacher). Study 2 merged teachers' and overall students' data. Study 3 merged teachers' data (with ratings of target students) and target students' data.

Appendix H: Author statement (CRediT)

The role of each author in each manuscript is specified based on the contributor role taxonomy (CRediT) by Brand et al. (2015)[16].

Li, P.-H., Mayer, D., & Malmberg, L.-E. (2022). Teacher well-being in the classroom: A micro-longitudinal study. Teaching and Teacher Education, 115, 103720. https://doi.org/10.1016/j.tate.2022.103720

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

Li, P.-H., Mayer, D., & Malmberg, L.-E. (2023a). Reciprocal relationship of teacher-student emotions in the classroom.

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

[16] Brand et al. (2015). Beyond authorship: attribution, contribution, collaboration, and credit. Learned Publishing, 28(2), 151-155.

Li, P.-H., Mayer, D., & Malmberg, L.-E. (2023b). Exploring teacher-student dyads: student engagement and teacher emotions.

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

Appendix I: Original paper of Study 1

Teacher well-being in the classroom: A micro-longitudinal study

by

Pei-Hsin Li, Diane Mayer, & Lars-Erik Malmberg, 2022

Teaching and Teacher Education, 115, 103720

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Research paper

Teacher well-being in the classroom: A micro-longitudinal study

Pei-Hsin Li*, Diane Mayer, Lars-Erik Malmberg

Department of Education, University of Oxford, United Kingdom

HIGHLIGHTS

- Teachers reported on lessons during one calendar week.
- Perceived student disruptive behaviour predicted teachers' negative emotions.
- Perceived student engagement predicted higher positive and lower negative emotions.
- Lesson-specific positive emotions predicted teachers' daily and general well-being.
- Lesson-specific negative emotions predicted teachers' exhaustion at the day-level.

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ABSTRACT

Given the high stress and attrition rate among teachers, there is a need to expand knowledge on situational experiences that contribute to teacher well-being. We investigated the links between student lesson-specific behaviour (disruptive behaviour, engagement), teachers' lesson-specific (positive, negative) emotions, daily (morning and end-of-working), and personal general well-being of 20 Taiwanese primary school teachers using a micro-longitudinal approach. By specifying multilevel structural equation models (MSEM), we found student behaviour predicts teachers' lesson-specific emotions, and this association varied across days and teachers. Teachers' lesson-specific positive emotions predict teachers' well-being, suggesting positive emotions can be a protective factor for teachers.

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1. Introduction

Research has shown that teaching is a high-stress profession, in which burnout is a prevalent phenomenon (Aloe et al., 2014; Buric et al., 2019; Pillay et al., 2005). With the increasing research interest in the topic of teacher well-being in recent years, teacher well-being has been recognised as a significant factor for students' well-being, student learning outcomes (Frenzel et al., 2018; Harding et al., 2019; Jennings & Greenberg, 2009; Roffey, 2012), and teachers' commitment to their teaching career (Chang et al., 2017). Yet, many studies mainly focus on the "dark side" of teacher well-being (e.g., exhaustion, burnout, or turnover rate) using the between-individual approach (Hagenauer et al., 2015; Simbula, 2010), and little is known about what contributes to teachers' well-being considering the classroom context where teachers interact with students in real-time, from one lesson to the other, day to day.

Insight into the dynamic (e.g., daily ups-and-downs) mechanism of teacher well-being in the classroom has far-reaching implications for creating a positive classroom climate and intervention applications. Teacher well-being, identified as organised at momentary and personal levels (Nettle, 2005) and proven to be changeable (Diener et al., 2017), could be manifested by its momentary feelings, namely emotions, such as joy (also referred to as "discrete emotions"). If teachers' situational experiences and momentary emotions in the classroom are shown to play an important role, programmes and strategies could be tailored to focus on how to support teachers in the school settings. Although momentary emotions are the situational form of well-being and contribute to one's satisfaction, it is not simply the sum of the positive emotional experiences minus the negative emotional experiences. To date, research on teacher emotions and teacher well-being is relatively fragmented concerning this process and how it relates to teachers' experiences in the classroom (Carson, Weiss, & Templin, 2010; Diener, 2017). Only a few studies have focused on

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two to three discrete teachers' emotions or the antecedents of teacher well-being in class using the momentary method (see Becker et al., 2015; Frenzel et al., 2015; Goetz et al., 2015).

Given the relatively limited understanding of teachers' momentary experiences and their relation to their well-being, this study aims to examine our modified teacher well-being model and goes beyond previous cross-sectional and longer-term longitudinal studies to investigate teacher well-being from a micro perspective. To this end, we investigated the relationship between situational in-class antecedents (students' behaviour: disruptive behaviour and engagement) and teachers' momentary emotions in real-time classroom experiences and then explore whether teachers' emotions can predict their day-level and personal general well-being. Therefore, we employed a micro-longitudinal study method with multiple assessments over lessons. A micro-longitudinal approach (e.g., experience sampling, momentary ecological assessment) reduces recall biases as it measures in-class behaviour and emotional elements directly at the end of each lesson. Moreover, it can elucidate and assess the micro-process of teacher well-being in an ecological context, enhancing contextual closeness (Bolger et al., 2013; Hamaker, 2012; Hamaker & Wichers, 2017).

1.1. The context of teaching in Taiwan

This study investigated teacher well-being in Taiwan. Teaching and education in Taiwan are largely influenced by Confucianism. Education is not a personal pursuit but related to social obligations, and teachers are expected to meet the social expectations of their roles and moral standards (Yen & Hwang, 2011). In other words, teaching in Taiwan is a calling in which teachers transmit knowledge, share a philosophy of life, are role models for students, and devote themselves to education. Therefore, teachers are under scrutiny by the public regarding their teaching skills and conduct.

As a result of the large education reform in 2001, called the Grade 1–9 Curriculum Reform, primary school teachers' roles have experienced a tremendous change. Teachers' status and authority have been reduced, the importance of interpersonal relationships and communication has risen, teaching methods have become more varied and complex, and the requirements for teachers' expected characteristics have become higher (Guo, 2006). As a result, teachers are feeling more stressed because of the higher expectations from society (Guo, 2006).

Primary education is the first part of compulsory education in Taiwan. Public primary school homeroom teachers teach multiple subjects (e.g., Mandarin, Mathematics, Integrative Activity, and other subjects) and spend almost all their day with the same group of students in schools. They are also important role models for children. It is worth noting that according to the report from Campus Security Report Center (2017, 2018, 2019), a centre that is responsible for dealing with events and contingencies on campus, there is an increasing trend of self-harm and suicide cases in teachers in recent years. However, the understanding of how teachers' well-being is related to their in-class experiences is relatively limited. Therefore, it is important to understand teachers' real-time teaching experience and emotions with children, and how to promote or at least maintain teachers' well-being.

1.2. Theoretical Underpinnings

To enable a holistic understanding of the dynamics of teacher well-being, this study used the multi-level structure to integrate different constructs of teacher well-beingbased on the broaden-and-build theory (Fredrickson, 1998) and the contributions of previous studies regarding emotions and teacher well-being (e.g., Cohn et al., 2009; Frenzel, 2014; Spilt et al., 2011).

An emotion starts with an individual's conscious or unconscious appraisal of an antecedent event, which then triggers a series of response tendencies that can be observed through subjective experience, facial expression, cognitive processing, and physiological changes (Fredrickson, 2001). The broaden-and-build theory of positive emotions (Fredrickson, 1998) posits that in contrast to negative emotions, positive emotions broaden a person's momentary thought-action repertoire and further build various personal resources to deal with challenges (Fredrickson, 1998, 2013). Negative emotions have been seen to narrow the attention of people (Fredrickson, 2013). They have the adaptive function ofpromoting specific actions, especially under immediate threats to survival. Unlike negative emotions, positive emotions benefit individuals' development and resource building through micro-moment accumulation in the long run. Additionally, positive emotions may loosen the aftereffects of negative emotions aroused by circumstances and further promote individuals' mental well-being and health (Fredrickson, 2013; Fredrickson & Levenson, 1998).

Although interwoven together, positive emotions and negative emotions have their own respective self-perpetuating cycles (Garland et al., 2015). The cycle of negative emotions narrows self-focus and leads to socially isolating thought-action tendencies, leading to subsequent negative emotions in turn. Thus, negative emotions trigger downward spirals. Positive emotions, on the other hand, trigger upward spirals by broadening individuals' mindsets and building resources, which in turn increase later positive emotions and enhance well-being and health. Upward spirals and downward spirals caused by positive emotions and negative emotions have significant differences in structure, not simply the opposite of each other. Despite the transient and fluctuating nature, positive emotions can have a long-term impact on enhancing well-being (Garland et al., 2010).

Empirical evidence supports the concept of the broaden-and-build theory that positive emotions undo or buffer the impact of negative emotions on detrimental physiological responses (e.g., Ong et al., 2006; Tugade & Fredrickson, 2004). Furthermore, positive emotions build resources, such as resilience and well-being (Cohn et al., 2009; Johnson et al., 2021; Nalipay et al., 2019), serving as indicators of optimal well-being (Fredrickson, 2001).

1.3. Unwrap teacher well-being

Teacher well-being, which captures teachers' professional fulfilment and happiness (Acton & Glasgow, 2015), is conceptualised as multifaceted with multiple layers (Diener et al., 2017). The concept of well-being includes individuals' overall satisfaction, domain-specific well-being, and emotional experiences (Diener, 2000, 2017). Teacher well-being research frequently focuses on teachers' job satisfaction or assesses overall well-being, especially how individual traits and school factors are associated with teacher well-being (Vorkapić & Peloza, 2017; Bermejo-Toro et al., 2016; Collie & Martin, 2017; Fernandes et al., 2019; Yildirim, 2014). However, based on the broaden-and-build theory (Fredrickson, 1998) and the insight from previous teacher well-being models (Cohn, 2009; Frenzel, 2014; Nettle, 2005; Spilt et al., 2011), momentary emotional experiences (positive and negative emotions) are first appraised by the antecedents, and power or depower personal resources. Then, momentary emotional experiences increase or decrease individuals' domain-specific well-being and then have an impact on their overall evaluation of life. We expanded previous research to modify well-being models and

examined it by assessing the constructs separately with three time-specific levels (situation, day, person) and presuming that momentary positive and negative emotions predict teachers' daily work-related well-being. Further, the accumulation of emotions impacts their general well-being, namely their overall life satisfaction.

Growth in stress does not require an absence of positive emotions and increases in resources do not require the non-existence of negative emotions (Fredrickson, 2013; Garland et al., 2010). Upward spirals caused by positive emotions and downward spirals caused by negative emotions are two distinctive cycle systems; thus individuals could experience positive and negative emotions simultaneously in everyday life (Trampe et al., 2015). When a teacher is experiencing positive emotions in school settings, resources can be built to deal with the challenges from work or boost their positive evaluation of their teaching work. In contrast, when a teacher is experiencing negative emotions in school settings, this then contributes to a repeated cycle of negative emotions and leads to emotional exhaustion or less engagement in work. As the accumulation of the positive and negative emotions, positive and negative emotions may have different impacts on domain-specific evaluations through their cycle systems and eventually lead to an increase or decrease in life satisfaction.

One function of positive emotions is the potential “undo effect,” which indicates that positive emotions could help people recuperate from stress (Fredrickson, 2013). We then proposed that positive emotions and negative emotions individuals experience during their work predict their daily evaluation of work-related (domain-specific) well-being differently. The accumulation of negative emotions leads to downward spirals and mainly has implications for the negative evaluations of individuals' work. The accumulation of positive emotions leads to upward spirals and has implications for the positive evaluations of individuals' workand it is protective in decreasing the negative evaluations of their work. In turn, the accumulation of emotions leads to an increase or decrease in general evaluations of life. Our statistical methodology enabled us to take account of these complex associations at the situational, daily, and personal levels.

1.4. Teacher emotion in class

Pekrun et al. (2002) pointed out that the emotions experienced during learning and instruction in school settings can be categorised as academic emotions. Chang and Cherng (2017) indicated that teachers, similar to students, have academic emotions regarding teaching, such as enjoyment, pride, and anxiety. Thus, students experience academic emotions from a learning aspect and teachers experience teaching emotions from lesson to lesson.

Research on teachers' emotions, especially teachers' emotional regulation, is not new (e.g., Jiang et al., 2016; Lee et al., 2016). These studies have investigated teachers' emotional management strategies. However, as Frenzel (2014) argued, existing literature is mainly based on interviews and not many studies have explicitly focused on teachers' emotions. Research that focuses on teachers' academic emotions, unlike students' emotions in school (Goetz et al., 2013; Pekrun et al., 2011; Schutz, 2014), is even more scarce. The existing body of literature has largely reported specific emotions instead of exploring multiple or general positive and negative emotions. The most common emotions used to investigate teachers’ teaching emotions are enjoyment, anger, and anxiety. However, evidence has shown that teachers may also experience other emotions such as pride and disappointment during teaching (Brígido et al., 2013; Prosen et al., 2011).

Research on emotions assumes that teachers' emotional experience has an impact on their well-being, especially occupational well-being. According to Fredrickson (2013), negative emotions are distinctive in their adaptive value, while positive emotions broaden a person's mindset and enhance one's well-being. However, less is known about how teachers' lesson-specific emotions are associated with their well-being and exhaustion.

1.5. Student behaviour as an antecedent of teacher emotions

Teachers' emotions are likely to be evoked in interaction with their students in class. Appraisal theory suggests that individuals' emotions are triggered by situations or events but caused by individuals' judgement about situations. In Frenzel's model, teachers' perceptions about student behaviour shape their emotions in class (Frenzel, 2014). In a momentary class situation, student behaviour such as their motivational behaviour (student engagement) and social-emotional behaviour (abide by the rules, student disruptive behaviour) may be the most obvious for teachers. When teachers perceive a higher level of student engagement that is consistent with their goals, they may experience positive emotions such as enjoyment. Conversely, if teachers perceive a low level of student engagement that is inconsistent with their goals, they may experience negative emotions such as anger. Additionally, when students misbehave in class, teachers may experience negative emotions such as anger or anxiety.

Empirical studies have provided some evidence that teachers' emotions are related to students' positive and negative behaviour in class, especially the connection between student disruptive behaviour and teachers' negative emotions. Student disruptive behaviour or lack of discipline is a key factor that arouses teachers' negative emotions, evokes responses such as anger or anxiety (de Ruiter et al., 2020; Hagenauer et al., 2015), and reduces teachers' level of enjoyment (Becker et al., 2015). Additionally, student disruptive behaviour has also been found to be a factor further heightening the risk of teachers' exhaustion over time (Aldrup et al., 2018; Aloe et al., 2014).

Compared to research on teachers' emotions and students' disruptive behaviour, research on how positive student behaviour in class predicts teachers' emotions is sparse. In Austria, Hagenauer et al. (2015) examined the effect of students' motivational behaviour (engagement) on teachers' emotions, including enjoyment, anger, and anxiety. They indicated that students' engagement in class contributes to teachers' positive emotions. Frenzel et al. (2020) addressed four types of student attainments (performance, motivation, discipline, and relationship attainment) and found that student engagement predicts teachers' enjoyment and anxiety, while the necessity to discipline students predicts teachers' anger and anxiety. This indicates that student engagement is a positive predictor of teachers’ positive and negative emotions.

The existing body of literature on teachers' emotions mainly focuses on limited emotions such as enjoyment, anger, and anxiety, but not a broader perspective that examines the entire range of positive and negative emotions (Frenzel, 2014). Interestingly, Becker et al.’s (2015) study revealed that teachers' positive emotions and negative emotions may be triggered through different pathways in which positive emotions were mainly induced by students' positive reactions in the class, while negative emotions were mainly induced by students' negative behaviour in the class. Thus, an unresolved issue is whether students' disruptive behaviour lessens teachers' positive emotions while student engagement decreases teachers' negative emotions.

1.6. The present study

We posed a modified theoretical model of teacher emotions and well-being in the teacher-student interaction context (see Fig. 1). In

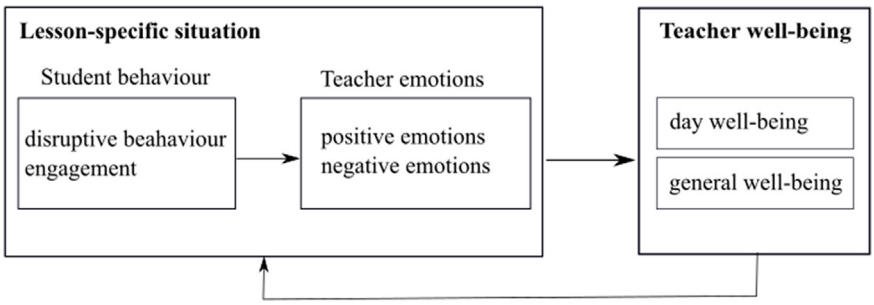

Fig. 1. Theoretical model.

this model, teachers' perceptions of student behaviour in lessons link with their situational emotions (lesson-specific). Teachers' emotions then further link with their well-being, including their daily work-related well-being and general well-being. In this study, we aimed to investigate how teachers' moment-to-moment emotions are related to students' behaviour. Additionally, the relationship between teachers' lesson-specific emotions, teachers' end-of-working well-being, and general well-being was investigated. We posed the following research questions that guided this study:

1. Do students' lesson-specific disruptive behaviour and engagement predict teachers' lesson-specific emotions? (lesson level)
2. Does the association between students' disruptive behaviour and teachers' emotions vary across days and teachers?
3. Does the association between students' engagement and teachers' emotions vary across days and teachers?
4. Does teachers' morning well-being (sleep quality and tiredness) moderate the relationship between students' behaviour (disruptive behaviour and engagement) and teachers' emotions?
5. How do teachers' emotions predict teachers' end-of-working well-being and general well-being?

We expected that lesson-specific student behaviour (student engagement, student disruptive behaviours) would predict teachers' emotions in class, and that student engagement mainly predicts teachers' positive emotions positively while student disruptive behaviour mainly predicts teachers' negative emotions positively. Also, teachers' morning well-being (sleep quality and tiredness) would moderate the relationship between students' behaviour and teachers' emotions. Further, we expected that teachers' momentary emotional experience would predict their end-of-working day well-being and their general well-being. However, we also expected that the way that positive emotions and negative emotions predict teachers' well-being would be different to some extent.

2. Method

We conducted a quantitative micro-longitudinal study to address the research questions. By using the micro-longitudinal method, we could capture teachers' momentary experiences such as academic emotions (e.g., Becker et al., 2014; Goetz et al., 2013) and perceptions of behaviour (e.g., Becker et al., 2014) through a sequence of repeated measurements in the classroom while reducing retrospective bias (Bamberger, 2016; Bolger et al., 2013; Hamaker, 2012). This section describes our sample, the measurements used, and the data analysis procedure.

2.1. Participant and procedure

In this study, participants were 20 homeroom teachers[1] (90% females) across eight public primary schools in Taiwan based on purposive and convenience sampling (see Table 1). In Taiwan, the percentage of primary school female teachers is over 70%, and those who are homeroom teachers are approximately 80% (Department of Statistics, 2021). Thus, the number of male and female participants in this study to some extent reflected the gender proportion of teachers in primary schools in Taiwan. Teachers taught either Year 4 or Year 5[2] (45% taught Year 4 and 55% taught Year 5) and their ages ranged from 28 to 55 ($M = 43.05$ years, $SD = 9.01$ years). Their teaching experience ranged from 2 years to 30 years ($M = 16.13$ years; $SD = 8.56$ years). In total, 308 students (46.8% females) participated in the study with their teachers. 132 students were in Year 4, and 176 students studied in Year 5 (57.1%) with an average age of 10.39 years (SD = 0.66, Range = 9.08 to 12.25, n = 306). Students' average academic performance in Mandarin was M = 86.71 (SD = 10.36; Range 43–100, skewness = −1.24, kurtosis = 1.81) and Mathematics was M = 81.51, SD = 14.80; Range 17–100, skewness = −1.39, kurtosis = 2.58). In general, Year 4 students perform better than Year 5 students in Mathematics ($t = 5.76$, $p < .001$) but not Mandarin ($t = 1.32$, $p = .19$.). Intraclass correlations showed that there were student-group differences in performance in Mandarin ($\rho_{ICC} = 0.25$) and mathematics ($\rho_{ICC} = 0.30$).

After obtaining university ethical approval, participants were invited through the headteacher to join the study for a calendar week during term time with written informed consent. An induction session was provided for each teacher in which the researcher fielded questions and the teacher filled in a brief paper-and-pencil questionnaire (n = 20) in order to understand background information and general well-being. Teachers were also instructed how to fill in the electronic day and lesson questionnaire on a tablet during the data collection period. They were asked to complete a morning questionnaire before starting work each morning and an afternoon questionnaire upon completion of each working day (90% compliance). Teachers were asked to report on each lesson during the last 5–10 min of each lesson or during the 10-min break afterwards if reporting during the lesson could not be completed. The median response time for completing lesson-specific questionnaires was less than 3 min (146 s). However, teachers were not always able to fill in the questionnaire during this interval because they were too busy with the students or the contingencies in the

[1] In primary schools in Taiwan, a homeroom teacher is attached to a certain homeroom of a group of students and in charge of looking after this group of students. Homeroom teachers teach multiple subjects, mainly including mathematics, Mandarin, and Integrative Activity.

[2] Children start primary school at the age of 6 in Taiwan.

Table 1
Teacher and student characteristics.

	Variables	*N (%)*	*M*	*SD*	Range	Skewness	Kurtosis
Teacher (n=20)	Gender						
	Male	2 (10.0%)					
	Female	18 (90.0%)					
	Age (year)	20 (100%)	43.05	9.01	28-55	−0.53	−1.17
	Teaching experience	20 (100%)	16.13	8.56	2-30	−0.22	−1.13
Student (n=308)	Gender						
	Male	164 (53.2%)					
	Female	144 (46.8%)					
	Grade						
	Year 4	132 (42.9%)					
	Year 5	176 (57.1%)					
	Age (year)	306 (99.4%)	10.39	0.66	9.08-12.25	0.04	−0.90

classroom. At the end of the research period, teachers filled in another brief paper-and-pencil questionnaire. All 20 teachers completed both paper-and-pencil questionnaires and electronic questionnaires. The feasibility of the procedure and the face-validity of all measures were piloted prior to the main study. On average, teachers reported on 13.15 lessons (SD = 1.95; range = 9–16) for 4.5 days (SD = 0.61; range = 3–5) within the research period, giving 249 lesson-specific reports included in analysis in total.

2.2. Measures

Measures in this study include questionnaires at three different levels (lesson, day, and teacher level). All measures were assessed on a 5-point Likert scale and are presented according to the different levels, as below.

2.2.1. Lesson-specific measurements

Student behaviour. Teachers reported their perceived student behaviour at the end of each lesson. In order to capture the positive and negative dimensions of student behaviour, we included student disruptive behaviour and student engagement. Drawing on the concept of students' disruptive behaviour from Kunter and Baumert (2006), teachers were asked how often students show disruptive behaviour in each lesson in 3 items (e.g., "In this lesson, to what extent did students disturb the instruction?", Aldrup et al., 2018). For overall student engagement, we used a single item to assess student engagement ("To what extent did students engage in this lesson?") to understand teachers' perceptions during the short transition between lessons to reduce the burden on participants. Internal consistencies (Cronbach's α, 0.84–0.87) and McDonald's omega (ω, 0.66 – 0.89) at each level (lesson, day, teacher) of student disruptive behaviour are shown in Table 2.

Teachers' emotions. We select emotions to be examined in the present study based on some selection criteria. First, we wanted to examine discrete emotions that are particularly related to classroom settings based on existing research (Pekrun et al., 2002, 2007; Goetz et al., 2013). Second, we take the results of our pilot examination of the emotions that teachers and students have in the culture-specific context (Taiwanese primary school teachers and students) into account. Teachers' emotions in class were measured by eight positive and negative emotions. Enjoyment, relaxation, pride, and calm were included to understand teachers' positive emotions, and disappointment, anxiety, anger, and boredom were included as negative emotions (Pekrun et al., 2002, 2007; Goetz et al., 2013; Watson & Tellegen, 1985). Two positive (enjoyment, pride) and two negative emotions (anger, anxiety) are categorised as activating emotions, and others are deactivating emotions (Pekrun et al., 2007). For each emotion, to limit the administration time and lower the burden on participants, we used a single item (Frenzel, 2015). Teachers were asked to rate how much they agreed with the sentences (e.g., This lesson, I felt relaxed) about their emotions in each lesson on a five-point Likert Scale ranging from 1 (not at all) to 5 (very much). Internal consistency (Cronbach's α) and the McDonald's omega (ω) of positive emotions and negative emotions were between 0.59 and 0.92 (see Table 2).

2.2.2. Day-level measurement

Morning well-being. We included two indicators (sleep quality and tiredness) that reflect teachers' emotional exhaustion state in the morning labelled as morning well-being in this study for their potential effect on emotions (Hülsheger, 2016). These indicators complete the loop of teachers' daily work-related well-being. Teachers were asked to respond to two single items on a five-point scale indicating teachers' morning status. Sleep quality was measured with the item "Did you sleep well last night?" (1 = very bad, 5 = very good). Tiredness in the morning was measured with the item "I feel tired this morning when I have to face another day at work" (1 = not at all, 5 = very much).

Teachers' end-of-working well-being. To understand teachers' domain-specific (work-related) well-being that covers both the positive and negative indicators, We integrated two negative and two positive work-related well-being that both reflect emotional-oriented (work enjoyment, burnout) and task-oriented (work buoyancy, work disengagement) according to the structure of previous research (for work enjoyment, buoyancy and disengagement, please see Collie et al., 2017; for emotional exhaustion, please see Maslach & Jackson, 1986). Teachers reported their work enjoyment in 4 items (e.g., "On the whole, I enjoy my work"; Martin, 2009), work buoyancy (capacity to deal with challenges effectively) in 4 items (e.g., "I think I'm good at dealing with work pressure"; Martin & Marsh, 2008), and their work disengagement in 3 items (e.g., "I've pretty much given up being involved in things at work"; Martin, 2010) at the end of their teaching work each day on a 5-point Likert Scale. The last element, emotional exhaustion, was measured with 8 items of the emotional exhaustion subscale of the Maslach Burnout Inventory (Maslach & Jackson, 1986). Teachers were asked to report the extent to which they agreed with each statement on that day (e.g., I feel emotionally drained from my work). Internal consistencies (Cronbach's α from 0.75 to 0.97) and McDonald's omegas (0.58–0.99) at different levels are shown in Table 2.

2.2.3. Teacher-level measurement

Teacher characteristics. We included a measure of teacher harmony belief adopted from Lu et al. (2001) as a covariate to

Table 2
Intercorrelations of variables.

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
1. PE	1												
2. NE	−0.61***	1											
3. DB	−0.15*	0.28***	1										
4. EN	0.51***	−0.51***	−0.28***	1									
5. SQ	0.24***	−0.31***	0.01	0.16*	1								
6. TR	−0.29***	0.27***	−0.02	−0.19**	−0.43***	1							
7. WE	0.58***	−0.46***	0.03	0.42***	0.38***	−0.46***	1						
8. WB	0.65***	−0.48***	−0.11	0.40***	0.29***	−0.31***	0.80***	1					
9. WD	−0.39***	0.40***	0.15*	−0.27***	−0.15*	0.16*	−0.52***	−0.42***	1				
10. EE	−0.34***	0.55***	0.08	−0.46***	−0.39***	0.38***	−0.59***	−0.49***	0.39***	1			
11.PrLS	0.57***	−0.67***	−0.22***	0.37***	0.32***	−0.21***	0.50***	0.57***	−0.58***	−0.48***	1		
12.PoLS	0.43***	−0.40***	0.13*	0.28***	0.28***	−0.39***	0.72***	0.50***	−0.38***	−0.56***	0.50***	1	
13. HB	0.44***	−0.48***	−0.30***	0.22***	0.30***	−0.26***	0.31***	0.34***	−0.48***	−0.19**	0.80***	0.33***	1
M	3.62	1.86	1.51	3.97	3.57	2.21	3.81	3.86	1.56	2.13	3.91	3.79	3.93
SD	0.62	0.69	0.53	0.63	1.06	1.28	0.74	0.58	0.54	0.72	0.77	0.76	0.49
ICC(L1)	0.33	0.34	0.39	0.45	–	–	–	–	–	–	–	–	–
ICC(L2)	0.09	0.09	0.08	0.08	0.61	0.40	0.14	0.26	0.32	0.30	–	–	–
ICC(L3)	0.59	0.56	0.52	0.46	0.39	0.60	0.86	0.74	0.68	0.70	–	–	–
α/ω (L1)	0.76/0.59	0.82/0.67	0.84/0.66	–	–	–	–	–	–	–	–	–	–
α/ω (L2)	0.77/0.79	0.82/0.84	0.87/0.77	–	–	–	0.94/0.69	0.87/0.65	0.75/0.58	0.91/0.83	–	–	–
α/ω (L3)	0.85/0.88	0.87/0.92	0.87/0.89	–	–	–	0.97/0.99	0.96/0.98	0.85/0.89	0.95/0.96	0.94/0.93	0.95/0.94	0.89/0.86

Note: ***p < .001, **p < .01, *p < .05. PE = positive emotions, NE = negative emotions, DB = student disruptive behaviour, EN = student engagement, SQ = sleep quality, TR = tiredness, WE = work enjoyment, WB = work buoyancy, WD = work disengagement, EE = emotional exhaustion, PrLS = Pre-Life satisfaction, PoLS = Post life satisfaction, HB = harmony belief, α = Cronbach's α, ω = McDonald's omega.

understand teachers' interpersonal beliefs that comes from the cultural context (values interpersonal harmony). Teachers' harmony belief is seen as a predictor of well-being in Chinese culture (Lu et al., 2001). Teachers were asked to report on a five-point scale (1 = strongly disagree, 5 = strongly agree) to what extent they agreed with 9 harmony belief items to examine their culture-specific beliefs about interpersonal relationships (e.g., I believe that people should have self-restraint). Cronbach's α for harmony belief is 0.89, and the McDonald's omega (ω) is 0.86 (Table 2).

Teacher general well-being. To understand teachers' general well-being, the Satisfaction with Life Scale (SWLS) developed by Diener et al. (1985) to examine individual subjective well-being (life satisfaction) was used. Teachers were asked to respond on a 5-point scale (1 = strongly disagree, 5 = strongly agree) on the extent to which they agreed with five statements (e.g., "In most ways my life is close to my ideal") at the beginning and at the end of the research. Cronbach's α of SWLS are 0.94 and 0.95 at two assessments, and the McDonald's omega (ω) are 0.93 and 0.94 at two assessments (Table 2).

2.3. Data analysis

The data for this study were conceptualised as a three-level model; comprised of lesson-specific ratings at the first level (L1), between-day ratings at the second level (L2), and between-individual ratings at the third level (L3). The hierarchical data were analysed using the Bayesian estimator (Asparouhov & Muthén, 2020; Muthén & Asparouhov, 2012) under the framework of multilevel structural equation models (MSEM) in Mplus 8 (Muthén & Muthén, 1998-2017). We centred predictors specified at a certain level in fixed effect models at the grand mean (CGM), and centred predictors for random slope models at the group mean (CWC) to provide meaningful interpretations.

The Bayesian approach uses the probability distribution over hypotheses to estimate a model (P(hypothesis | data)) in contrast to null hypothesis testing in frequentist paradigms (Van De Schoot et al., 2014). It better accommodates conditions (e.g., small sample size) that may lead to estimation problems in Maximum Likelihood (Hox et al., 2012; Zitzmann et al., 2016) which is suitable for the relatively small sample size (n = 20) in the present study. Using Bayesian estimation enables researchers to gain robust and accurate estimations of parameters in small sample size situations with diffuse priors (e.g., as few as 13 units at higher-level) or incorporate admissible-range-restricted prior (e.g., 15 units at higher-level with 25 timepoints at lower-level) for multilevel SEM analysis (Hox, 2012; McNeish, 2019; Zitzmann, 2016). We specified uninformative prior for the parameters in this study (Heemskerk & Malmberg, 2020).

We started by investigating the variance components of emotions to evaluate how large variation in emotions could be attributed to the lesson (L1), the day (L2), and the teacher (L3). To answer the first research question 'Do students' lesson-specific disruptive behaviour and engagementpredict teachers' lesson-specific emotions', we specified Model 1(M1) to analyse the fixed-effect of lesson-specific characteristics on teacher emotions. Following the fixed-effect model, we conducted a set of random intercept, random slope models (M2) to investigate whether there are day or individual differences in the association between student

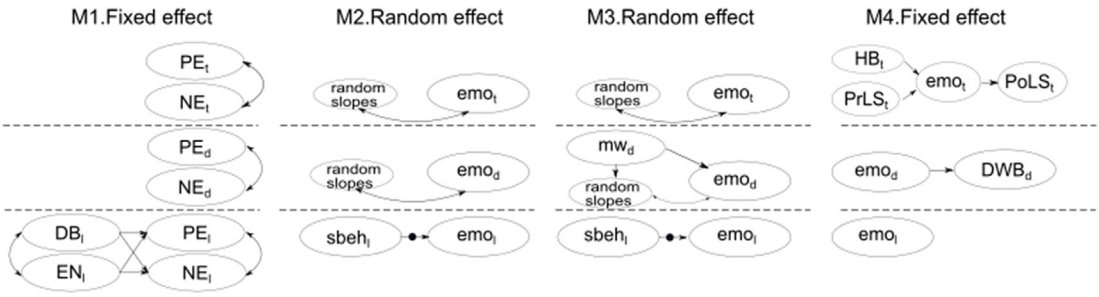

Fig. 2. Hypothetical models for analysis.

behaviour variables and teacher emotions (Research questions 2 and 3). We then investigated the potential cross-level interaction based on the random intercept, random slope model (M3) to investigate the moderating role of daily morning well-being (Research question 4). Finally, we included end-of-working well-being variables (L2) and general well-being variables (L3) in Model 4 to investigate the relationship between teachers' lesson-specific emotions and end-of-working well-being and general well-being (Research question 5). The hypothetical models of each step are shown in Fig. 2.

3. Results

3.1. Descriptive statistics

On average, teachers have a more positive evaluation of their general well-being and end-of-working well-being. Teachers' positive emotions are above the midpoint of the scale ($M = 3.62$, $SD = 0.62$), while teachers reported a relatively low level of negative emotions ($M = 1.86$, $SD = 0.69$). Consistent with previous studies that mainly focused on enjoyment, anger, and anxiety (e.g., Frenzel et al., 2015; 2016, using a 4-point Likert scale), the negative emotions were low while the positive emotions were above the midpoint of the scale (e.g., the score of enjoyment in Frenzel et al. (2015) was 3.10 in the 4-point Likert scale.). Intercorrelations of study variables on the lesson level are given in Table 2.

We then inspected intraclass correlations (ICC)[3] to assess the extent teacher emotions varied within lessons, between days, and between teachers. The ICC showed that a large proportion of variance of emotion lay at the teacher level: positive emotions were 0.59 (teacher), 0.09 (day), and 0.33 (lesson). Negative emotions were 0.56 (teacher), 0.09 (day), and 0.34 (lesson).

3.2. Lesson-specific student behaviour and teachers' lesson-specific emotions

Following model 1 (M1), we inspected fixed effects of teacher perceived lesson-specific student disruptive behaviour and student engagement on teachers' positive and negative emotions. The effect of teacher-rated student disruptive behaviour on teachers' negative emotions was significant ($\beta = 0.19$, 95% credibility interval (C.I.) [0.02, 0.35]), showing that the more student disruptive behaviour the teachers perceived, the higher the negative emotions. Additionally, the effect of student engagement on teachers' negative emotions was significant negatively ($\beta = -0.44$, C.I. [−0.57, −0.31]), indicating that the more the students were involved in class, the fewer negative emotions teachers experienced.

[3] ICC(teacher) = $s^2_{(t)}/s^2_{(t)}+s^2_{(d)}+s^2_{(l)}$, ICC(day) = $s^2_{(d)}/s^2_{(t)}+s^2_{(d)}+s^2_{(l)}$, ICC(lesson) = $s^2_{(l)}/s^2_{(t)}+s^2_{(d)}+s^2_{(l)}$, where t = teacher, d = day, and l = lesson.

However, there was no significant effect of student disruptive behaviour on teachers' positive emotions ($\beta = -0.00$, C.I. [−0.16, 0.17]). Student engagement predicted teachers' positive emotions ($\beta = 0.53$, C.I. [0.41, 0.64]), showing that the more students engaged in the lesson, the more teachers experienced positive emotions.

3.3. Day and individual differences in the association between student disruptive behaviour and teachers' emotions

Following Model 2 (M2), we specified random terms (positive/negative emotions regressed on student disruptive behaviour in separate models) at the lesson level. We inspected the variance of the slope at the day level, and the mean and variance of the slope at the teacher level.

In terms of positive emotions, the average slope at the teacher level was $B = -0.06$ (C.I. [−0.28, 0.18]) with a variance of $\psi = 0.05$ (C.I. [0.00, 0.19]). The variance at the day level was $\psi = 0.09$ (C.I. [0.00, 0.22]). The steepness of the slope was not related to the day average positive emotions ($\rho = 0.04$, C.I. [−0.02, 0.10]) or teacher average positive emotions ($\rho = -0.01$, C.I. [−0.19, 0.19]).

For negative emotions, the average slope at the teacher level was $B = 0.19$ (C.I. [−0.16, 0.58]) with a variance of $\psi = 0.27$ (C.I. [0.00, 0.87]). The variance at the day level was $\psi = 0.37$ (C.I. [0.08, 0.78]). The steepness of the slope was related to the day average negative emotions ($\rho = 0.11$, C.I. [0.01, 0.22]), but not to the teachers' average negative emotions ($\rho = -0.13$, C.I. [−0.50, 0.20]). This means that when the day average negative emotions are higher, the slope is steeper (i.e., disruptive behaviour predicts relatively more negative emotions for a particular teacher). Thus, the results show that the association between student disruptive behaviour and negative emotions varies across both days and teachers.

Overall, the results show that the association between student disruptive behaviour and negative emotions varies across both days and teachers. The association between student disruptive behaviour and positive emotions also varies across days or teachers.

3.4. Day and individual differences in the association between student engagement behaviour and teachers' emotions

Similarly, following Model 2 (M2), we then specified random terms (positive/negative emotions regressed on student engagement in separate models) at the lesson level, and inspected the variance of the slope at the day level, and the mean and variance of the slope at the teacher level.

For positive emotions, the average slope at the teacher level was $B = 0.34$ (C.I. [0.18, 0.51]) with a variance of $\psi = 0.03$ (C.I. [0.00, 0.11]). The variance at the day level was $\psi = 0.06$ (C.I. [0.00, 0.17]). The steepness of the slope was not related to the day average positive emotions ($\rho = 0.01$, C.I. [−0.02, 0.05]), nor to teacher average positive emotions ($\rho = -0.03$, C.I. [−0.17, 0.08]). The results

show there is a significant deviation of individual slope from the average slope across days and teachers.

In terms of negative emotions, the average slope at the teacher level was $B = -0.32$ (C.I. [−0.49, −0.13]) with a variance of $\psi = 0.03$ (C.I. [0.00, 0.13]). The variance at the day level was $\psi = 0.05$ (C.I. [0.00, 0.16]). These indicate a significant deviation of individual slope from the average slope across days and teachers. The steepness of the slope was not significantly related to the day average negative emotions ($\rho = -0.02$, C.I. [−0.07, 0.03]), nor the teacher average negative emotions ($\rho = -0.01$, C.I. [−0.17, 0.13]).

Overall, the results show that the association between student engagement and teacher emotions (positive and negative) varies across both days and teachers.

3.5. The moderating role of teachers' morning tiredness and the quality of sleep on the association between student behaviour and teachers' emotions

Following Model 3 (M3), we included day-level moderators (morning well-being: sleep quality and tiredness) of the association between student behaviour (student disruptive behaviour and student engagement) and teachers' emotions (positive and negative).

First, the positive/negative-emotions-on-student-disruptive-behaviour slopes were regressed on teachers' morning well-being, respectively. We found a moderation effect that teachers' morning quality of sleep predicted the slope ($B = -0.43$, C.I. [−0.74, −0.10]). In other words, the higher the morning quality of sleep, the less steep the slope. However, we do not find a moderation effect regarding the relationship between student disruptive behaviour and positive emotions ($B = 0.15$, C.I. [−0.10, 0.34]).

Next, the positive/negative-emotions-on-student-disruptive-behaviour slopes were regressed on teachers' tiredness in the morning. No moderation effect was found regarding positive emotions ($B = -0.02$, C.I. [−0.20, 0.17]) or negative emotions ($B = 0.08$, C.I. [−0.17, 0.33]).

When the positive/negative-emotions-on-student-engagement slopes were regressed on teachers' sleep quality in the morning, there is no other significant moderation effect of sleep quality on the positive-emotions-on-student-engagement slopes ($B = -0.06$, C.I. [−0.18, 0.13]) as well as the negative-emotions-on-student-engagement slopes ($B = 0.04$, C.I. [−0.12, 0.24]). Similarly, no other moderation effect was found of tiredness on the association between student engagement and teachers' positive emotions ($B = 0.05$, C.I. [−0.06, 0.17]) or negative emotions ($B = -0.08$, C.I. [−0.13, 0.12]).

3.6. Teachers' lesson-specific emotions and teachers' end-of-working well-being and general well-being

Following Model 4 (M4), we then included fixed effects of teachers' end-of-working well-being and teacher-level general well-being (life satisfaction) into the model to examine whether teachers' positive and negative emotions further predict their well-being at the day level and teacher level. Results show that a higher level of teachers' daily average positive emotions significantly predicted more work enjoyment ($\beta = 0.60$, C.I. [0.15, 0.90]), and a higher level of work buoyancy ($\beta = 0.76$, C.I. [0.39, 0.97]), with a marginal effect of emotional exhaustion ($\beta = -0.39$, C.I. [−0.72, 0.01]) at the end of working but not work disengagement ($\beta = -0.12$, C.I. [−0.50, 0.36]). This means that a teacher who experiences a higher level of positive emotions on a particular day has a higher level of work-related well-being, especially in work enjoyment and buoyancy. In a similar vein, when teachers experience higher levels of positive emotions during the day, it is likely that they have lower levels of exhaustion at the end of that working day. At the teacher level, we also found that teachers' positive emotions were significantly predicted by teachers' general well-being (life satisfaction) before the research period ($\beta = 0.72$, C.I. [0.14, 1.20]) and then predicted life satisfaction at the end of the research period ($\beta = 0.58$, C.I. [0.15, 0.88]). However, there was no significant relationship between teachers' positive emotions and teachers' harmony belief ($\beta = 0.07$, C.I. [−0.52, 0.63]) when controlling for life satisfaction (correlation (r) between harmony belief and positive emotion was 0.44, see Table 2).

Teachers' daily negative emotions only predicted teachers' end-of-working exhaustion ($\beta = 0.60$, C.I. [0.14, 0.95]) at the day level. Also, teachers' negative emotions had a significant relationship with teachers' life satisfaction (general well-being) at the beginning ($\beta = -0.98$, C.I. [−1.35, −0.59]) and predicted teachers' life satisfaction at the end ($\beta = -0.55$, C.I. [−0.86, −0.13]) of the research period. Thus, if teachers have higher levels of life satisfaction, they tend to have lower levels of negative academic emotions during the research period, and then have higher life satisfaction at the end of the research week.

4. Discussion

This research extends the previous research on the role of teacher emotions in real-time during one calendar week. Particular attention was given to how teacher emotions were predicted by student behaviour in real-time classrooms, the variability across days and teachers, and how teacher emotions further predict teachers' daily and individual level well-being.

4.1. Intraindividual variability

Inconsistent with previous studies on teacher emotions (Becker et al., 2015; Frenzel et al., 2015) who found that approximately 15%–30% of the variance in emotions (specifically enjoyment, anger, and anxiety) lies at the teacher level, we found that the majority of variance in teachers' positive and negative emotions between teachers (59% and 56%). However, we also found a considerable amount of variance in teachers' emotions due to different lessons (33%–34%). Therefore, teacher emotions are different between individual teachers and also fluctuate across different lessons. Interestingly, to some extent, the results of this study reflect the findings of de Ruiter (2020), despite the fact that their definitions for levels in their research (within students, between students, and between teachers) differ from this study. They found that the majority of variance for anger was due to students (teacher reports of students, student level ICC = 0.21), and that the variance for self-related emotions (Teacher level ICC = 0.20) and anxiety (Teacher level ICC = 0.23) were mainly due to teacher characteristics. In the studies by Becker et al. (2015) and Frenzel et al. (2015), participants were mainly secondary school teachers in Germany and the data had a two-level structure (lessons nested in teachers), while de Ruiter et al. (2020) used the day reconstruction focussing on teachers' perceptions toward specific students (students nested in teachers). Unlike previous studies, we grouped teacher emotions into positive and negative emotions and analysed teacher emotions based on a three-level structure (lesson, day, and teacher). It is worth noting that the participants in our study were primary school homeroom teachers in Taiwan and cultural differences do exist regarding emotion intensity and expression (Jack et al., 2012).

Based on the findings of previous cross-cultural research (Sims et al., 2015), one possible explanation is that Taiwanese teachers may have lower arousal and intensity of emotions and have less variability from one lesson to another. This may reflect the implicit

"emotion rules" in the culture that teachers are expected not to express negative emotions or even "bring no emotion to the student" (Yin & Lee, 2012). Therefore, Taiwanese teachers may not express such fluctuated emotions as teachers in previous research across lessons.

4.2. Students' situation-specific behaviour and teachers' academic emotions

Results of this study showed that students' situation-specific behaviours, including disruptive behaviour and engagement, were significant predictors of teachers' emotions. When teachers perceived more student disruptive behaviour during teaching, they tended to have higher levels of negative emotions in class. This result reflects the findings of previous studies that student disruptive behaviour predicts teachers' anger and anxiety (de Ruiter et al., 2020; Hagenauer et al., 2015). Previous research indicates that student disruptive behaviour is correlated to teachers' emotional exhaustion and work enthusiasm, and the link between student disruptive behaviour and emotional exhaustion exists even if the teacher-student relationship was taken into consideration (Aldrup et al., 2018). Regarding teachers' positive emotions, no significant relationship between student disruptive behaviour and teachers' positive emotions was found in the current study. This indicates that students' disruptive behaviour in real-time lessons does not derail teachers' positive emotions but is mainly related to teachers' negative emotions such as anger.

In line with previous cross-sectional research on student motivational behaviour and teacher emotions (Hagenauer et al., 2015), we found a significant effect of student engagement on teachers' positive emotions as well as negative emotions. Thus, when teachers feel that students engage in the lesson emotionally and behaviourally, they tend to experience more positive emotions and fewer negative emotions. Previous research only included teachers' anger, joy, and anxiety as teacher emotions, and the results indicated that joy and anger, but not anxiety were predicted by student engagement (Hagenauer et al., 2015). Further research is needed on the potential discrepancies between different discrete emotions.

4.3. The variability of student behaviour and teachers' emotions and moderating effects

Our findings suggest that the effect of disruptive behaviour on teachers' positive emotions varied across days and individuals, and the effect of student disruptive behaviour on teachers' negative emotions also varied across both days and teachers. In addition, we found the effect of student engagement on teachers' positive and negative emotions varied across both days and individuals. That means, for some days, student behaviour (including student disruptive behaviour and engagement) has a large effect on teachers' positive and negative emotions, and for some teachers, student disruptive behaviour has a large effect on their negative emotions. Our findings regarding student behaviour and teachers' emotions reflect the fluctuation of the lesson and day-based nature of teacher emotions, as well as the differences between individual teachers.

Apart from the variability, we also found a moderating effect of teachers' self-rated sleep quality in the morning (morning well-being) on the relationship between student disruptive behaviour and their negative emotions. This indicates that teachers' morning well-being (sleep quality) has a positive effect on teachers' emotions in reacting to students' disruptive behaviour. Teachers' sleep quality appears to help teachers manage their negative emotions when students misbehave in the classroom. Poor sleep quality could increase teachers' stress and irritability when they interact with students (Poon et al., 2019). This implies that teachers' recuperation at the beginning of a new day plays an important role in their interaction with students.

4.4. Teacher emotions predict teacher well-being

The findings of the current study show that teachers who have higher levels of positive emotions are more likely to have higher work enjoyment and work buoyancy at the end of the working day. However, teachers' negative emotions only predict teachers' emotional exhaustion at the end of the working day. In other words, the more intense the negative emotions teachers experience during the day, the more exhausted they feel. This is in line with the idea that positive emotions build up resources and help to increase an individual's well-being (Cohn et al., 2009; Fredrickson, 2003, 2013). Teachers' positive emotions and negative emotions may work as two pathways. While negative emotions contribute to their judgement about how exhausted they are during work, positive emotions in lessons increase teachers' feeling of work-related well-being.

At the individual level, analyses showed that teachers' emotional experience in class (lesson-specific well-being) is reflected in teachers' overall level of life satisfaction (general well-being). The more positive emotions and fewer negative emotions teachers have in class, the more they are satisfied with their life as a whole. The present study shows the link between teachers' situational emotions and their daily work-related well-being as well as their general well-being.

4.5. Limitations and suggestions for future research

The findings of this study should be taken with the following limitations in mind. Firstly, the sample size at the teacher level was relatively small and the sample consisted of mostly females. Although the gender distribution in our research reflects the gender distribution in Taiwanese primary schools and our initial analyses showed no gender effects on teachers' general well-being, this may be due to the limited sample of male teachers. The second limitation is that in this study participants were recruited voluntarily. This could lead to bias if generally teachers who have high well-being with better classroom management experiences were more willing to participate in the research. Motivating a variety of teachers to participate in research with a larger sample size to validate findings would be beneficial in future research.

Third, we only used teachers' self-report data to analyse the relationship between student behaviour, teacher emotions, and teachers' well-being. Additionally, to lower the burden on participants, we only used a single item to assess the teachers' overall perceptions of their students' engagement in each lesson. Although the main aim of the current research is to understand teachers' momentary experiences regarding interaction with students and their well-being, it would be desirable to use multiple items for measurements and integrate other methods, such as external observations or student-report, to understand classroom conditions and teachers' response in class.

Moreover, despite the advantages of the Bayesian paradigm in mitigating the limitation of the Maximum Likelihood (ML) estimator and its robust estimation for small samples (Asparouhov & Muthén, 2020), it is not without limitations. One main limitation of a Bayesian paradigm is the potential subjectivity in selecting priors (Van De Schoot et al., 2014), thus it is crucial to specify priors based on informative prior knowledge. In this study, to mimic ML estimates, we specified diffuse priors (Heemskerk and Malmberg, 2020; Zitzmann et al., 2016), while it would be even more beneficial for future research to specify weakly informative priors

(McNeish, 2019).

Finally, it is worth noting that the current research was conducted in a specific cultural context. Future studies are needed to understand teacher well-being from micro perspectives in different cultural contexts. In this study, we included individuals' belief in interpersonal harmony conducted based on Chinese culture, which is recognised as a cultural specificity element that relates to personal well-being (Lu et al., 2001). Our results show that as a cultural backdrop, teachers' harmony belief is related to different aspects of teachers' appraisal of their experiences and well-being. It would be beneficial for future studies to take cultural specificity and the corresponding measurements into account.

4.6. Practical implications for practitioners

The ultimate goal of this study is to increase understanding of how teachers' real-time experience contributes to well-being. Such understanding will help teachers develop an awareness of their own emotional experiences when interacting with students, for example, the effect of student behaviour on teachers' emotions. In turn, this study could urge educators and policymakers to identify the potential ways to effectively support teachers in cultivating well-being.

An implication arising from this study echoes previous research on teacher enjoyment (e.g., Becker et al., 2015; Keller et al., 2014). Teachers report emotional exhaustion but also feel that their work is rewarding at the end of their working day, and this is related to their emotions in the classroom. In line with the theory (Fredrickson, 1998), the positive emotional experience could increase the personal resource with the existence of negative emotions. Thus, supporting teachers to be aware of their emotions and accumulate small positive emotions in the classroom could be beneficial to teachers' work-related well-being, and eventually increase their evaluation of life in general.

Another implication of the findings is that teachers' perceptions of student motivational (engagement) and discipline behaviour (disruptive behaviour) contribute to the variability of teacher emotions in the real-time classroom. Among them, a higher level of students' motivational behaviour relates to both higher positive emotions and lower negative emotions. This is especially true in primary schools, as primary homeroom teachers connect with the same group of students in a stronger way. Interventions that help teachers to develop effective classroom management strategies, such as elevate students' engagement while decreasing disruptive behaviour (e.g., behaviour-specific praise) in the classroom are needed (Gage & MacSuga-Gage, 2017; Larson et al., 2021).

Additionally, our findings also revealed that teachers' well-being is a cycle system that ties the teachers' situational experiences in school settings and their lives together (e.g., sleep quality, cultural context). There are approximately one-third of Taiwanese primary school teachers feel stressed in their work and about one-fifth feel that their work has negative impacts on their physical or psychological health (Ko et al., 2019). Changing teachers' situational experiences in school settings could help these teachers. Thus, training projects that guide teachers to accumulate positive experiences and recuperate from work stress or exhaustion could spark off a positive loop in the classroom.

5. Conclusion

The present study was designed to integrate teachers' teaching and emotional experiences in class and their overall well-being, to point out how different layers of teacher well-being are connected with each other by utilising a micro-longitudinal approach. The results of this study are important in expanding the understanding of teachers' positive and negative academic emotions, and their empirical relationships with daily occupational well-being and their judgement of their life as a whole.

Teachers' perceptions of student behaviour, including both disruptive behaviour and engagement are important for their emotional experiences in class. Teachers experience more negative emotions in lessons with more student disruptive behaviour such as chatting and other off-task behaviours, or if students do not actively engage in the lesson. However, when teachers perceive that students are involved in class overall, this not only increases their positive emotions but also decreases teachers' negative emotions. The results of the current study also suggest that teachers' academic emotions in class indeed predict their evaluation of their work-related well-being at the end of the working day, as well as how satisfied they are with their life as a whole.

This study provides a first step in studying teacher well-being from their momentary academic emotions to their life-satisfaction as a process. This expands previous research on teacher well-being from a trait perspecitve and teachers' emotions from a state perspective. The findings of this study imply that teacher support programmes should focus on teachers' experiences and emotions when teaching. Studying the relationship between teacher-stated emotional experiences related to students, evaluation about work, and judgements about life helps to expand our knowledge about the dynamic of teaching and learning and different ways to support teachers.

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