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Teachers' situation-specific mastery experiences: teacher, student group and lesson effects

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Abstract Following a model on the cyclical nature of teacher ("trait") self-efficacy and context-, task- and situation-specific ("state") *mastery experiences* (TSSME), we investigated the variability and effects of lesson characteristics (e.g. lesson sequence), student group characteristics (e.g. proportion of students receiving free school meals) and teacher characteristics (e.g. teacher experience) on teachers' situation-specific mastery experience. Forty-three teachers reported on 1,055 lessons in 385 student groups using electronic questionnaires in Personal Digital Assistants during a period of 2 weeks. Two domains of TSSME (support of learning and organisation of classrooms) and perception of students (engagement and behaviour) were found. Multilevel models found roughly a quarter of the variance in TSSME between teachers, a quarter between student groups and half between lessons. Student group characteristics differentially predicted TSSME. Perceived student engagement was more predictive of TSSME than perceived student behaviour. More experienced and high-efficacy teachers had higher TSSME. The findings have implications for our understanding of teachers' everyday practice with different student groups.

Keywords Teacher self-efficacy · Mastery experience · Situation specific

Introduction

Teachers who believe that they are able to engage, support and manage students' learning and academic performance, even in difficult circumstances, have a sense of efficacy, referred

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to as teacher self-efficacy (TSE). Prior successes—mastery experiences—build a robust basis for personal efficacy while failure undermines it (Bandura 1997, p. 80). Personal efficacy then provides a basis for expectations of future success (Bong and Skaalvik 2003; Tschannen-Moran et al. 1998), interactions in classrooms and with colleagues and higher levels of commitment (Coladarci 1992) and a prolonged stay in the profession (Glickman and Tamashiro 1982). Research shows that high TSE is related to teaching of high-track students (Raudenbush et al. 1992), adaptive student–teacher interaction (Gibson and Dembo 1984), and fewer concerns about classroom management (Woolfolk and Hoy 1990) and students' expectations and performance (Midgley et al. 1989). Several authors have called for studies in which *situational*, *contextual* and person effects on TSE would be disentangled (e.g. Dellinger et al. 2008; Gibson and Dembo 1984; Tschannen-Moran et al. 1998), but we are, to the best of our knowledge, not aware of such a study. Such a study could enable us to better understand teachers' everyday experiences when dealing with the same and different student groups within a particular timeframe. Uniquely, Raudenbush et al. (1992) and Ross et al. (1996) disentangled variability in TSE according to contextual factors (i.e. student groups) and person (i.e. teacher).

We expand on previous studies of TSE in two ways. First, in line with cyclical models of personal beliefs of efficacy and its relationship with teachers' situation-specific mastery experiences (TSSME), we investigated the variability and predictors of TSSME during day-to-day practice in real-time in schools. Teachers evaluated their mastery of engaging students, supporting students' higher-order thinking and organising the classroom during lessons over a 2-week period, reporting these in electronic questionnaires in personal digital assistants (PDA). To date, Carson et al. (2010) report only four experience sampling studies on teachers' emotions using such devices (but for a diary study, see Frenzel and Götz 2007). We explore a multidimensional short-form measure for investigating TSSME beliefs and perceived student engagement at the situation (i.e. lesson) level, when previous studies have relied on single item indicators (Raudenbush et al. 1992; Ross et al. 1996). Second, while previous studies have operationalized the magnitude of TSE (i.e. level of difficulty, obstacle or barrier; Bandura 1997) at the item level (e.g. "… I can get through, *even to the most difficult of students*"), we in the present study include student group and situational characteristics as indicators of difficulty. This aspect of TSE has often been conceptualised (e.g. Tschannen-Moran et al. 1998; Tucker et al. 2007) but there is only, to the best of our knowledge, one empirical investigation of TSE and such demographic variables (Pas et al. 2007).

Teacher self-efficacy

Human agency stems from a person's history of successes and failures. Mastery experiences of past performance form a basis for concurrent self-evaluations,[1] which in turn provide a basis for expectations of future success (Bong and Skaalvik 2003). Teacher self-efficacy is defined as "teachers' belief or conviction that they can influence how well students learn, even those who may be difficult or unmotivated" (Guskey and Passaro 1994, p. 4). A sequence of mastery experiences gives rise to a higher sense of efficacy, while a series of

[1] In the literature on control beliefs (Skinner 1996) and action–control beliefs (Little 1998) parallel concepts have been used. Skinner (1996) distinguished between "agent-means beliefs" as the distinct means (e.g. skills, resources, competences) termed agency, capacity and efficacy expectations, while the "means-ends link" refers to whether a certain mean gives rise to a certain outcome termed, e.g. mean-ends, strategy and outcome expectancy beliefs. Actions of agentic persons are considered volitional, goal-oriented and self-regulatory, and they believe they have the capacity, skills, resources and abilities to realise goals (Little 1998).

failures will thwart the sense of self-efficacy (Bandura 1997, p. 80). A high sense of efficacy based on past successes enables one to set moderate to high performance goals (Bandura 1997, p. 122), perform well in subsequent tasks (even when controlling for prior performance) and self-enhance on a range of motivational variables (Bong and Skaalvik 2003). To the best of our knowledge, there is to date no report of such a full cyclical model, in which a sequence of prior and subsequent beliefs have been proposed: prior self-efficacy predicting performance, performance predicting mastery experience, mastery experience predicting subsequent self-efficacy, self-efficacy predicting performance and so on. Two previous studies suggest this model would be plausible. Firstly, Bandura and Wood (1989) showed a cyclic relationship between performance and self-efficacy, mediated through a range of motivational processes. Second, a within-person study showed that (enactive) mastery experiences inreased alongside self-efficacy as the difficulty level of tasks was raised (Bandura et al. 1982).

The biggest distinction between person-specific ("trait") TSE and situation-specific ("state") TSSME is that the former denotes forethought (as the individual believes he or she can exert actions for realizing a certain goal or anticipates a positive outcome) while the latter denotes immediate retrospection of the outcome of one's actions. In the present study, we propose situation-specific measures of mastery experiences (TSSME) as self-evaluation of success (or failure) in creating an optimal learning environment for students. In keeping with intra-person research in other research fields (e.g. Carson et al. 2010), we investigated the variability of TSSME across lessons of the same student group, between different student groups of the same teacher and between teachers. In the two existing within-teacher studies of TSE (i.e. differences in TSE of the same teachers across student groups), Raudenbush et al. (1992) and Ross et al. (1996) found variability in TSE according to contextual (i.e. student groups) and person (i.e. teacher) effects. They found more than half of the variability between teachers, while Raudenbush et al. (1992) found more than half of the variance between teachers and Ross et al. (1996) more than three quarters.

Individual differences in teacher self-efficacy

Two broad areas of research on TSE are found: that on the number of and measurement qualities of domain-specific TSE (e.g. Tschannen-Moran and Woolfolk Hoy 2001) and on relationships between teacher characteristics and TSE.

Tschannen-Moran and Woolfolk Hoy (2001) proposed a tri-partite domain-specific measure of TSE in order to measure the extent to which teachers think they can affect student learning outcomes through the means of student engagement, classroom management and instructional strategies. There are several replications of this tripartite distinction (Klassen et al. 2010), but other subdivisions of the construct do exist (see Bandura 1997; Malmberg and Hagger 2009; Skaalvik and Skaalvik 2007). Furthermore, the tripartite distinction generalises quite well into neighbouring research fields, such as observed student–teacher interaction or classroom quality (La Paro et al. 2004; Malmberg et al. 2010) and teacher effectiveness[2] (Opdenakker and Van Damme 2006).

[2] In these parallel research fields, researchers have conceptualised the emotional, organisational and cognitive domains of teaching using slightly different terminology: autonomy support, structure and teacher involvement (Skinner and Belmont 1993); emotional support, classroom organisation and instructional support (La Paro et al. 2004); personal learning support, classroom management and cognitively challenging elements (Kunter and Baumert 2006); and learner-centred teaching style, orderly classroom management and content-centred teaching style (Opdenakker and Van Damme 2006).

Previous studies of TSE have shown an association between TSE and high-quality classroom management (Woolfolk et al. 1990), job satisfaction (Caprara et al. 2003), level of commitment (Coladarci 1992), teaching level (Wolters and Daugherty 2007) and teachers' perception of job-related stress (Skaalvik and Skaalvik 2007). Furthermore, studies have suggested that teachers have low self-efficacy due to concerns about classroom management (Woolfolk and Hoy 1990), and the ability to be seen as an authority (Veenman 1984). Some studies have shown that teacher self-efficacy is related to longer teaching experience (Gabriele and Joram 2007; Klassen and Chiu 2010), but these finding are inconsistent (Ghaith and Yaghi 1997). Gender differences in TSE have also been found, for example male teachers having a lower level of TSE than female teachers (Raudenbush et al. 1992).

Student groups and contexts

Raudenbush et al. (1992) assumed that TSE is necessary, but not sufficient for effective teaching (p. 151). Contextual factors such as student group characteristics matter. Some student groups pose more of a challenge for teachers, for example if there are many low-performing students in the groups or if the majority of the students come from a disadvantaged neighbourhood. In one of the two existing within-teacher studies of TSE, Raudenbush et al. (1992) found that TSE was higher when teaching academic and honours classes than when teaching non-academic classes explained by the higher engagement of the former students (see also Guo et al. 2011; Ross et al. 1996). Furthermore, Raudenbush et al. (1992) found that TSE was lower in smaller classes. As these are frequently remedial classes attended by low-achieving students, this would constitute a greater challenge to the teacher, hence a lower TSE. These findings show that contextual factors such as academic performance, track, year group and class size affect TSE.

In the UK, the context of the present study, Blatchford et al. (2011) found teachers in larger groups use more direct instruction, focus less on individual students and students interact less with teachers in larger than in smaller groups. In lower-attainment groups, students exhibit more on-task behaviour in smaller than in larger student groups (Blatchford et al. 2011). Academic performance and progression of UK students is also predicted by background characteristics, such as low socioeconomic status, parents' unemployment, gender (girls outperforming boys) and ethnicity (white students outperforming non-white; Sammons 1995; Sammons et al. 1995). Being eligible for free school meals (FSM) is significantly correlated with student attainment, type of school (e.g. private, state), school mobility, living in care, special needs, first language and minority ethnic group (Gorard 2012). Such student group characteristics would pose challenges for the teacher, either directly (if there were a larger proportion of lower-performing students in the group) or indirectly (if these students were less engaged in learning). Although higher TSE teachers believe that they can impact student learning despite external influences such as socioeconomic status, motivation and school status (Tucker et al. 2007), Pas et al. (2007) found no effect of school-level organisational health ratings, student mobility, student suspension, student enrolment and principal turnover on TSE. As these school level variables are proxies of students' background (e.g. poverty, disadvantage, at risk), there is a dearth of studies which have incorporated student group level or school-level variables of disadvantage as predictors of TSE.

Situations and task

Bandura (1997) suggests that experiences of mastery can come about in many ways depending on the level of challenge of the situation. If a task is optimally challenging, a sense of mastery will follow success. If a task is too easy or too difficult, a sense of mastery might not follow. Following the suggestions of analyses of teachers' task by Tschannen-Moran et al. (1998), we propose to include the exploration of where in a teaching cycle a lesson is located. In teachers' working cycles, more preparation is often required for new topics, or adapting a certain topic to a certain student group, than it is for revision or assessments. We included variables catering for the particular segment of the teaching sequence, as well as student engagement each lesson, as student engagement is likely to vary over time (see Malmberg et al. 2010).

As a high sense of efficacy based on past successes enables one to withstand temporal failure (Bong and Skaalvik 2003, p. 5), it is expected that high TSE teachers would be able to cope well in difficult situations, for example refocusing disengaged students, or efficiently managing a chaotic student group. In a previous observational study of student–teacher interaction with high and low TSE teachers, the former spent more time on whole group instruction and monitoring of student work and displayed greater patience with low-achieving pupils (Gibson and Dembo 1984). Thus, an important expansion of previous research would be to investigate whether TSE would moderate the relationship between challenging conditions to teach in, and mastery experiences. In other words, do high TSE teachers experience more success in problematic student groups or in more challenging situations?

Research questions

We investigated the following research questions:

1. How do teachers' situation-specific mastery experiences vary across lessons, student groups and teachers?
2. What are the effects of personal characteristics (e.g. gender, teaching experience) on teachers' situation-specific mastery experiences?
3. What are the effects of student group characteristics (e.g. average academic performance) on teachers' situation-specific mastery experiences?
4. What are the effects of lesson characteristics (i.e. lesson sequence, perceived student engagement) on teachers' situation-specific mastery experiences?
5. Does teacher self-efficacy moderate the relationships between student group and lesson characteristics on situation-specific mastery experiences?

Hypotheses

Hypothesis 1 If the finding from two-level studies (i.e. student groups nested within teachers) expands to a three-level design (i.e. lessons nested in student groups, nested in teachers), we would expect to find more than half of the variance at the teacher level, as Raudenbush et al. (1992) found 56 % and Ross et al. (1996) found 76 % of the variance in TSE between teachers.

Hypothesis 2 We expected positive effects of teacher gender (females higher) experience and self-efficacy on TSSME (Gabriele and Joram 2007; Klassen and Chiu 2010; Raudenbush et al. 1992).

Hypothesis 3 We tentatively assumed that proxies for student disadvantage (Gorard 2012; Sammons 1995; Sammons et al. 1995) would predict TSSME either directly through need of increased instructional support of low-performing students (which teachers might not be prepared for or do not feel they have sufficient time to do), or indirectly through lower levels of engagement of students from disadvantaged backgrounds (Appleton et al. 2008). Thus, we expected positive effects of average academic performance (Raudenbush et al. 1992) and proportion of girls (who have a higher level of engagement; Appleton et al. 2008) and negative effects of performance homogeneity (requires more individualisation and adaptation of the curriculum and tasks to individual students; Corno 2008), group size (more students makes individualisation more difficult, and there is less time for each student; Corno 2008) and proportion of students eligible for FSM (Gorard 2012; Sammons 1995; Sammons et al. 1995).

Hypothesis 4 We tentatively expected teachers to vary in their TSSME as different segments of a teaching sequence are related to more of less preparation (Tschannen-Moran et al. 1998). In line with previous studies, we expected a positive effect of student engagement on TSSME (Malmberg and Hagger 2009; Ross et al. 1996; Raudenbush et al. 1992).

Hypothesis 5 As a high sense of efficacy based on past successes enables one to withstand temporal failure (Bong and Skaalvik 2003, p. 5), we expected that high self-efficacy teachers would feel more successful in difficult situations or with difficult student groups (Bandura 1997).

Method

Sample and procedure

Initially, we recruited 52 teachers in two large (>1,500 students) secondary schools, one urban and one rural, to take part in the Teaching Every Lesson (TEL) project, in southeast England, UK. Both schools catered for 11–18 year olds from a broad range of socio-economic backgrounds and the urban school for a wide range of ethnic backgrounds. Compared to the national average of 13.4 % of students in state-funded secondary schools in 2009 who were eligible for free school meals (Department for School and Children and Families [DSCF] 2009), the student groups in our sample were less disadvantaged (7.0 %; see Table 1). A member of staff in a pedagogical leadership role invited all teachers to participate. We offered all teachers a feedback report of their individual results after the data collection, which fitted well with continuing professional development of staff in both schools at the time of the project.

Fifty-two teachers participated in a session in which they signed consent forms, filled in a brief teacher questionnaire (n=51) and single-page student group questionnaires about each group (48 teachers reported on 452 student groups) they were currently teaching, and were instructed how to fill in the electronic lesson questionnaire on a PDA during the 2-week data collection period (46 teachers started using the PDAs). Of the 52 teachers, one completed only the PDA questionnaires and another one did not return the student group questionnaires rendering linkage to school archive data impossible. Electronic data was not recovered from two PDAs due to technical errors and we were unable to link student group data to school archive data for one teacher.

Table 1 Teacher, student group and lesson characteristics

	n	Range	*M*/%	SD
Teacher (*n*=43)				
Age	43	23–61	35.5	9.4
Gender (0=male, 1=female)	43		64.70 %	
Teaching experience	43	0.5–40.0	7.7	8.2
Teacher self-efficacy	43	3.20–5.65	4.52	0.48
Student group (*n*=385)				
Average academic performance (*M*)	333	2.05–12.86	6.27	2.49
Academic performance heterogeneity (SD)	332	0.00–4.38	0.92	0.69
Year group	369	7–13	9.47	1.93
Group size	344	3–35	22.72	6.80
% Girls	345	0.00–1.00	0.47	0.18
% Free school meals (FSM)	343	0.00–0.43	0.07	0.07
Lesson (*n*=1,055)				
Sequence	1,050			
Introduction to new topic	262		25.0	
Consolidation	429		40.9	
Revision	204		19.4	
Assessment	94		9.0	
Other	61		5.8	
Teacher's situation-specific mastery experience				
Learning support	1,052	1.00–5.00	3.9	0.74
Classroom organisation	1,052	1.00–5.00	3.7	0.91
Teacher's situation-specific perception of students				
Engagement	1,055	1.00–5.00	4.2	0.66
Behaviour	1,054	1.00–5.00	4.4	0.66

Using PDAs for situation-specific reporting reduces retrospective bias (Hektner et al. 2007). We applied a fixed time point structure to data collection (Beal and Weiss 2003; Carson et al. 2010), so that teachers were asked to report on each lesson during the last 10 min of each lesson or during the immediate break afterwards if reporting during the lesson proved problematic. In order to streamline data collection, we had pre-programmed the PDAs to include a grid with all the student groups the teacher was currently teaching. This grid was used for linking PDA data with student group information extracted from the school archive called the Student Information Management Systems (SIMS) in the schools. This school-specific database includes internal records of student background, performance and progression in each subject they study. We used information that was compatible across the two schools and was possible to aggregate at the student group level. We received SIMS data of 419 student groups.

We achieved a total study sample of 43 teachers (*M*=2.74, SD=1.4; range=1–7 lesson per group per teacher), who reported on 1,055 lessons (*M*=24.5, SD=7.55; range, 8–40) of 385 student groups (*M*=8.9, SD=3.12; range, 3–21 per teacher). Fourteen of the teachers were male and 29 were female; their average age was 35.5 years. They had on average been teaching for 7.7 years (see Table 1). They taught 28 different school subjects or

combinations thereof: 12 taught mathematics or science, 6 languages, 5 physical education, 8 social sciences (e.g., history and art) and 12 professional topics (e.g. IT).

Measures

Teacher characteristics Teachers reported their gender (0=male, 1=female), age and teaching experience (see Table 1). Preliminary analysis showed no effects of (dummy coded) teaching subject, and thus it was not included in further analyses.

We included a measure of TSE modified from Tschannen-Moran and Woolfolk-Hoy (2001) and Malmberg and Hagger (2009). Teachers were asked to respond on six-point scales (1=strongly disagree, 6=strongly agree) to what extent they agreed with 20 statements (e.g. "I feel confident that I can engage the students" (six items for TSE for student engagement; α=0.72), "I feel confident that I can promote students' reasoning and problem solving skills" (six items for TSE for instruction; α=0.66) and "I feel confident that I can set clear expectations for pupils' work" (eight items for TSE for classroom organisation; α=0.81)).

Student group characteristics We derived aggregate variables on student groups' school performance (i.e. teacher-reported curriculum level of the most recent performance). We aggregated these into the *average academic performance* in each group and the standard deviation as an index of *academic performance heterogeneity*. We also derived the total number of students in each group (*group size*), the proportion of girls (*% girls*) and the proportion of students who received free school meals (*% FSM*). For analyses, we also included students' year group (*year group*). However, we observed potential sources of colinearity in the student group data. Average academic performance was strongly positively correlated with year group (r=0.83; p<0.001, as could be expected because curriculum levels are absolute, not relative measures of performance), as well as with academic performance heterogeneity (r=0.61; p<0.001). Younger year groups were larger (r=−0.57; p<0.001). In an attempt to accommodate threats to colinearity, we standardised (M=0; SD=1) average academic performance (zperf), academic performance heterogeneity (zperfSD) and group size (zgroupsize) within each year group prior to analyses.

Lesson-specific measures Teachers completed measures of lesson sequence, TSSME and perceived student engagement using the PDA. As the measures of TSSME and perceptions of students were novel, we tested the structural validity of these using multilevel confirmatory factor analysis (MCFA; Reise et al. 2005) in Mplus 7.0 (Muthén and Muthén 2012).

Teachers' situation-specific mastery experiences TSSME was measured with six items, probing success for engaging students, stimulating higher-order thinking and managing behaviour (see Table 2). We modified items from previous studies (Dellinger et al. 2008; Malmberg and Hagger 2009; Tschannen-Moran and Woolfolk Hoy 2001) and assessed face validity through informal discussions with teachers and teacher educators. Teachers were asked each lesson to respond to the question "this lesson, how successful were you at…" on five-point scales (0=not at all, 1=slightly, 2=somewhat, 3=quite a bit, 4=very much): engaging students ('supporting students', 'motivating students'), stimulating higher order thinking ('making students understand', 'promoting higher thinking') and organising the class ('maximising time on task', 'minimising disruptions'). Using MCFA in which lessons $_{(i)}$ were nested within student groups $_{(j)}$ nested within teachers $_{(k)}$, we compared one-, two

and three-factor solutions, equating the factor loadings across the levels. Using goodness of fit indices for excellent fit of below 0.05 on the root mean square error of approximation (RMSEA) and the standardised root mean residual (SRMR) for the within ($SRMR_W$) and between ($SRMR_{Bj}$ and $SRMR_{Bk}$) parts of the model respectively, and above 0.95 on the comparative fit index (CFI; Browne and Cudeck 1993), the one-factor solution fit data relatively well ($\chi^2_{[35]}=100.04$; $p<0.001$; RMSEA=0.042; $SRMR_W=0.042$; $SRMR_{Bj}=0.088$; $SRMR_{Bk}=0.074$; CFI=0.950), but modification indices were high for the two classroom organisation items, suggesting a separate factor. The three-factor solution, although it fit data excellently ($\chi^2_{[24]}=80.33$; $p<0.001$; RMSEA=0.047; $SRMR_W=0.031$; $SRMR_B=0.063$; $SRMR_{Bk}=0.096$; CFI=0.957), showed that the correlation between the engaging students and stimulation higher-order thinking constructs was above 1, suggesting merging the two. Thus, a two-factor solution in which the engagement and higher-order thinking items loaded onto one factor, here called "learning support" for brevity, and the classroom organisation on its own, showed appropriate model fit ($\chi^2_{[32]}=94.16$; $p<0.001$; RMSEA=0.047; $SRMR_W=0.031$; $SRMR_{Bj}=0.063$; $SRMR_{Bk}=0.097$; CFI=0.952) and healthy parameter estimates. Thus, it seemed a reasonable choice to use these two constructs for further analyses (see Table 2).

Lesson characteristics Teachers reported the type of lesson they were teaching in relation to the overall sequence in which the lesson was located: 1=introduction of new topic ($n=244$; 25.4 % of all lessons), 2=consolidation ($n=389$; 40.4 %), 3=revision ($n=196$; 20.4 %), 4=assessment ($n=89$; 9.3 %) and 5=other ($n=44$; 4.6 %). Sequence was coded into four dummy variables using assessment as baseline.

Student engagement Following Fredricks et al. (2004), teachers were asked to respond to the question "what were the students like during the lesson?" on five-point scale (0=none of them, 1=few of them, 2=some of them, 3=most of them, 4=all of them) indicating emotional engagement (i.e. 'motivated' and 'disengaged'), cognitive engagement ('on-task' and 'distracted') and behaviour (i.e. 'well behaved' and 'disruptive'). Also here a two-factor solution fit data best suggesting two constructs: student engagement and behaviour ($\chi^2_{[32]}=83.09$; $p<0.001$; RMSEA=0.039; $SRMR_W=0.035$; $SRMR_{Bj}=0.037$; $SRMR_{Bk}=0.121$; CFI=0.966; see Table 2).

Analytic strategy

Missing data Missingness was sparse in the teacher questionnaire (0.09 % of the data points) and in the PDA questionnaire (0.46 % of the data points). When SIMS data was linked with lesson reports (PDA), 10.6 % of the data points were missing (SD=3.5 %; range, 0–6 covariates missing). We imputed the data using a multilevel imputation in Mplus 7.0 (Muthén and Muthén 2012), using all possible information in our database for improved efficiency of imputation estimates (Collins et al. 2001; Schafer and Graham 2002). We imputed all lesson-level items (also items pertaining to constructs not analysed here), student group covariates (the six covariates which were compatible across the schools) and an additional teacher report of relative student group performance levels from the student group questionnaire. We specified teacher level variables as fixed effects at the student level including a series of dummy codes to account for the differences between teachers and a dummy code for school at the third level, as Mplus handles imputation of data in two hierarchical levels. To take the uncertainty of the missing student group level information into account, we carried out all analyses using five imputed datasets (Little and Rubin 2002).

Table 2 Teachers' situation-specific mastery experience and perception of students (multilevel confirmatory factor analyses (MCFA) for two-factor solutions)

	Within		Between (student groups)		Between (teachers)	
	λ	R^2	λ	R^2	λ	R^2
Teacher situation-specific mastery experience						
This lesson; how successful were you at …. (0=not at all, 4=very much)						
Learning support						
Supporting students	0.70	0.49	0.84	0.71	0.86	0.74
Motivating students	0.66	0.43	0.73	0.54	0.74	0.54
Promoting higher thinking	0.76	0.54	1.00	0.85	0.92	1.00
Making students understand	0.75	0.57	0.98	1.00	0.96	0.84
Classroom organisation						
Minimising disruptions	0.73	0.56	0.92	0.96	1.00	0.92
Maximising time on learning tasks	0.43	0.18	0.71	0.51	0.50	0.25
Correlation between ηs	0.86		0.92		0.59	
Teacher situation-specific perception of students						
This lesson; to what extent were the students …. (0=none of them, 4=all of them)						
Engagement						
Motivated	0.77	0.60	0.93	0.87	0.98	0.97
Disengaged	−0.59	0.43	−0.97	0.98	−0.69	0.69
On-task	0.73	0.61	0.98	1.00	0.82	1.00
Distracted	−0.67	0.35	−0.99	0.94	−0.83	0.48
Behaviour						
Well behaved	0.78	0.53	1.00	0.97	1.00	0.68
Disruptive	−0.57	0.32	−0.94	0.89	−0.80	0.64
Correlation between ηs	0.86		0.88		0.77	

The MCFA was carried out in Mplus 7.0 (Muthén and Muthén 2012) using the THREELEVEL command. Factor loadings (λ) are standardised coefficients (STDYX)

Multilevel models We carried out a series of multilevel models, in three levels (lessons $_{(i)}$ nested in student groups $_{(j)}$ nested in teachers $_{(k)}$; Hox 2002), using the robust maximum likelihood estimator in Mplus 7.0 (Muthén and Muthén 2012). We first specified a variance component model (Eq. 1). The random effects allows inspection of variability in TSSME, i.e. the extent to which lessons deviate from the lesson average (at level 1; e_{0ijk}), how student groups deviate from the average student group (at level 2; υ_{0jk}) and how teachers deviate from the grand average (at level 3; ν_{0k}), the grand average represented as b_0.

$$\mathrm{TSSME}_{ijk} = b_0 + v_{0k} + u_{0jk} + e_{0ijk} \quad (1)$$

In model 2, we investigated the effects of teacher characteristics by including two fixed effects at the teacher level, gender (0=male, 1=female) and the grand mean centred ($x_k - \overline{x}$; Enders and Tofighi 2007) teacher experience and domain-specific TSE (Eq. 2). In the model

of TSSME for learning support, we included TSE for engaging student and instruction; in the model of TSSME for behaviour, we included TSE for classroom organisation.

$$\text{TSSME}_{ijk} = b_0 + b_1\text{teacher age}_k + b_2\text{teacher experience}_k + b_3\text{T}SE_k + v_{0k} + u_{0jk} + e_{0ijk} \quad (2)$$

We then investigated the effects of student group characteristics on TSSME by including six grand mean centred predictors in model 3. This corresponds with the *inter*-teacher analysis by Raudenbush et al. (1992) in which teacher responses to student group and school characteristics are estimated when these deviated from the typical (average) student group of all teachers. By doing this, effects of contextual factors across teachers are compared (Eq. 3), average performance (zperf), performance heterogeneity (zperfSD), year group (yeargroup), group size (zgroupsize), proportion of girls (%girls) and proportion of students who receive free school meals (%FSM):

$$\text{TSSME}_{ijk} = b_0 + b_{1-3}\text{teacher characteristics}_k + b_4\text{zperf}_{jk} + b_5\text{zperfSD}_{jk} + b_6\text{yeargroup}_{jk} + b_7\text{zgroupsize}_{jk} + b_8\%\text{girls}_{jk} + b_9\%\text{FSM}_{jk} + v_{0k} + u_{0jk} + e_{0ijk} \quad (3)$$

In model 4, we investigated the effects of lesson characteristics, by including fixed effects of lesson sequence (dummy coded, using assessment as baseline), and the grand-mean centred perceived student engagement and behaviour (Eq. 4).

$$\text{TSSE}_{ijk} = b_0 + b_{1-3}\text{teacher characteristics}_{jk} + b_{4-9}\text{student group characteristics} + b_{10-14}\text{ sequence (dummy coded)} + b_{15}\text{engagement}_{jk} + b_{16}\text{behaviour}_{jk} + v_{0k} + u_{0jk} + e_{0ijk} \quad (4)$$

Finally, we, one by one, included cross-level TSE×lesson and student group characteristics interactions into model 4.

Results

Variance components We first inspected variance components in model 1, carried out separately for TSSME of supporting learning (Table 3) and organising the classroom (Table 4). Teachers varied in their TSSME of supporting learning (19 %) and organising the classroom (30 %). Teachers varied across their taught student groups with regard to TSSME of learning support (23 %) and classroom organisation (21 %). Within each of the student groups, there was considerable variability from one lesson to the other: 58 % for learning support and 49 % for classroom organisation. When only observing between-teacher and between-student group variances, our findings suggest a smaller between-teacher variance and larger within-teacher variance (23+58=81 % of TSSME of learning support and 21+49=70 % for TSSME of classroom organisation) than Hypothesis 1 suggested.

TSSME and teacher characteristics We then included fixed effects of teacher characteristics in model 2, which improved model fit in the learning support model ($\Delta-2\text{LL}_{[3]}=22.0$;

$p<0.001$) explaining 47 % of the variance at the teacher level[3] (Table 3), and in the classroom organisation model ($\Delta-2LL_{[3]}=15.6$; $p<0.01$), explaining 32 % of the variance at the teacher level (Table 4). In line with Hypothesis 2, more experienced teachers felt more successful in supporting students' learning ($B=0.02$; ES[4]=0.54), as did teachers who had a higher level of TSE for engagement and instruction ($B=0.33$; ES=0.58). Likewise, more experienced teachers felt more successful in organising the classrooms ($B=0.02$; ES=0.46), as did teachers who had a higher level of TSE for classroom organisation ($B=0.26$; ES=0.30). No effect of gender was found. Supplementary analysis showed no additional effect of teacher experience squared on competence evaluation, indicating that mid-career teachers evaluated their competence neither higher nor lower than early-career or end-of-career teachers.

TSSME and student group characteristics We then included fixed effects of student group characteristics in model 3, which did not significantly improve model fit in the learning support model ($\Delta-2LL_{[6]}=11.0$; $p=0.088$) explaining 12 % of the variance at the student group level (Table 3) and in the classroom organisation model ($\Delta-2LL_{[6]}=17.4$; $p<0.01$), explaining 16 % of the variance at the student group level (Table 4). Hypothesis 3 was only partially supported as teachers felt more successful in supporting students' learning in higher performing student groups ($B=0.11$; ES=1.04). There were two significant fixed effects of student group characteristics on TSSME of classroom organisation showing that teachers felt more successful in organising the classroom in more heterogeneously performing student groups ($B=0.08$; ES=0.13) and less successful in groups in which a larger proportion of students were registered for free school meals ($B=-1.19$; ES=−0.20).

TSSME and lesson characteristics We then included fixed effects of lesson characteristics in model 4, which improved model fit in the learning support model ($\Delta-2LL_{[6]}=78.6$; $p<0.001$) explaining 23 % of the variance at the lesson level and in the classroom organisation model ($\Delta-2LL_{[6]}=144.1$; $p<0.001$), explaining 24 % of the variance at the lesson level. As we can see in Table 3 (model 4) that teachers felt more successful in supporting student learning during introductions to new topics ($B=0.51$), consolidation ($B=0.43$) and revision of ongoing topics ($B=0.54$) than during assessments (i.e. the baseline category). In line with Hypothesis 3, teachers felt relatively more successful in supporting student learning when more of the students in the group were engaged ($B=0.43$; ES=1.04) than when they were well behaved ($B=0.21$; ES=.50). As we can see in Table 4 (Model 4), TSSME for classroom organisation did not differ across different sequences. Teachers felt relatively more successful in organising the classroom when more of the students in the group were engaged ($B=0.45$; ES=0.71) than when they were well behaved ($B=0.28$; ES=0.44).

When we compare models 3 and 4, we see that including lesson characteristics into the model diminished the fixed effect of student group characteristics and increased the proportion of the explained variances at the student group level in line with the results of Raudenbush et al. (1992) suggesting an indirect effect of student group characteristics on

[3] We calculated the explained variance as the proportion of total level-specific error variance (Hox 2002), for example: $R^2_{\text{level2}}=\left(\frac{\sigma^2_{e|b}-\sigma^2_{e|m}}{\sigma^2_{e|b}}\right)$, where $\sigma^2_{e|b}$ is the lowest level residual variance for the baseline model and $\sigma^2_{e|m}$ that for the comparison model, giving $R^2_{\text{level2}}=\left(\frac{0.124-0.066}{0.124}=0.468\right)$.

[4] Effect sizes were calculated using recommendations by Marsh et al. (2009): $ES=(2\times B\times SD_{\text{predictor}})/\psi$, where B is the unstandardised regression coefficient in the MLM, $SD_{\text{predictor}}$ is the standard deviation of the predictor variable at level 2 and ψ the total variance of the dependent variable.

Table 3 Teacher, student group, and lesson effects on teachers' situation-specific mastery experiences of supporting student learning

	Model 1		Model 2		Model 3		Model 4	
	B	SE	*B*	SE	*B*	SE	*B*	SE
Intercept	3.79	0.06***	3.80	0.05***	3.79	0.05***	3.39	0.22***
Teacher								
Female teacher			−0.09	0.10	−0.07	0.11	0.00	0.08
Teaching experience			0.02	0.01**	0.02	0.01**	0.01	0.01*
Teacher self-efficacy (engagement and instruction)			0.33	0.07***	0.29	0.08***	0.17	0.06**
Student group								
School performance mean					0.11	0.05*	0.03	0.04
School performance SD					0.00	0.04	−0.03	0.04
Year group					0.02	0.02	−0.02	0.02
Group size					−0.04	0.04	0.00	0.03
% Girls					0.21	0.20	0.19	0.16
% Free school meal					−0.54	0.55	0.05	0.36
Lesson								
Sequence (baseline; assessment): introduction to new topic							0.51	0.23*
Consolidation							0.43	0.21*
Revision							0.54	0.24*
Other							−0.04	0.31
Perceived student engagement							0.43	0.06***
Perceived student behaviour							0.21	0.06**
Variance	σ^2		σ^2		σ^2		σ^2	
Teacher	0.12	0.03***	0.07	0.02***	0.07	0.02***	0.05	0.02***
Student	0.15	0.02***	0.15	0.02***	0.13	0.02***	0.06	0.02***
Lesson	0.37	0.05***	0.37	0.05***	0.37	0.05***	0.28	0.04***

Table 3 (continued)

	Model 1		Model 2		Model 3		Model 4	
	B	SE	*B*	SE	*B*	SE	*B*	SE
Test-2LL	2,269.6		2,251.9		2,234.0		1,885.8	
Test-2LL			22.0	***	11.0		78.6	***
Variance	Variance %		Explained %		Explained %		Explained %	
Teacher	0.19		0.47		0.40		0.58	
Student group	0.23		n.a.		0.12		0.56	
Lesson	0.58		n.a.		n.a.		0.23	

Predicted values are average parameter estimates across five imputed dataset from Mplus 7.0 (Muthén and Muthén 2012). We used Wald tests of significance for fixed effects and for random effects applied the correction factor by Berkhof and Snijders (2001): $2(LR_1 - LR_0)$ for extracting the χ^2 value, using p/2 as significance level. As the behaviour of the log likelihood when using the robust maximum likelihood estimator (MLR) using multiple imputed datasets is unknown, we proceeded as follows to provide a plausible relative model fit. We computed the difference of H_0 (baseline model) and H_1 (comparison model) for the Satorra–Bentler corrected degrees of freedom (i.e. as Mplus provides the scaling factor; Muthén and Muthén 2012)

*$p<0.05$; **$p<0.01$; ***$p<0.001$

Table 4 Teacher, student group, and lesson effects on teachers' situation-specific mastery experience of organising classrooms

	Model 1		Model 2		Model 3		Model 4	
	B	SE	*B*	SE	*B*	SE	*B*	SE
Intercept	3.86	0.08***	3.86	0.07***	3.86	0.06***	3.85	0.05***
Teacher								
Female teacher			−0.20	0.15	−0.20	0.15	−0.16	0.09
Teaching experience			0.02	0.01**	0.02	0.01**	0.02	0.01**
Teacher self-efficacy (classroom organisation)			0.26	0.10**	0.24	0.10*	0.17	0.09
Student group								
School performance mean					0.07	0.05	−0.01	0.04
School performance, SD					0.08	0.04*	0.05	0.03
Year group					0.01	0.02	−0.03	0.02
Group size					−0.05	0.05	−0.02	0.03
% Girls					0.27	0.20	0.22	0.15
% Free school meal					−1.19	0.57*	−0.58	0.35
Lesson								
Sequence (baseline, assessment): introduction to new topic							0.00	0.11
Consolidation							0.02	0.11
Revision							0.03	0.13
Other							−0.12	0.17
Perceived student engagement							0.45	0.06***
Perceived student behaviour							0.28	0.06***
Variance			σ^2		σ^2		σ^2	
Teacher	0.24	0.07***	0.16	0.05***	0.17	0.06***	0.16	0.05***
Student	0.16	0.03***	0.16	0.03***	0.14	0.03***	0.07	0.02***
Lesson	0.38	0.03***	0.38	0.03***	0.38	0.03***	0.29	0.03***

Table 4 (continued)

	Model 1		Model 2		Model 3		Model 4	
	B	SE	*B*	SE	*B*	SE	*B*	SE
Test-2LL	2,346.4		2,332.4		2,309.2		1,959.5	
			15.6	**	17.4	**	144.1	***
Variance proportions/explained variance	Variance %		Variance explained		Variance explained		Variance explained	
Teacher	0.30		0.32		0.27		0.34	
Student group	0.21		n.a.		0.16		0.59	
Lesson	0.49		n.a.		n.a.		0.24	

Predicted values are average parameter estimates across five imputed dataset from Mplus 7.0 (Muthén and Muthén 2012). We used Wald-tests of significance for fixed effects, and for random effects applied the correction factor by Berkhof and Snijders (2001): $2(LR_1 - LR_0)$ for extracting the χ^2 value, using p/2 as significance level. As the behaviour of the log-likelihood when using the robust maximum likelihood estimator (MLR) using multiple imputed datasets is unknown, we proceeded as follows to provide a plausible relative model fit. We computed the difference of H_0 (baseline model) and H_1 (comparison model) for the Satorra-Bentler corrected degrees of freedom (i.e. as Mplus provides the scaling factor)(Muthén and Muthén 2012)

*$p<0.05$; **$p<0.01$; ***$p<0.001$

TSSME through student engagement and behaviour. Also the effect of TSE for classroom organisation dropped below significance (B=0.17; p=0.07; ES=0.19). Supplementary analysis showed that student group average performance was indeed a predictor of student engagement (B=0.10; p<0.05). Student behaviour was predicted by student group performance heterogeneity (B=0.08; p<0.05) and a larger proportion of FSM students in the group (B=−1.20; p<0.05).

We finally tested a series of cross-level interaction effects (e.g. TSE for classroom organisation × % FSM) on each TSSME. We found no significant interaction effects.

Discussion

Following a cyclical model of TSE and their situation-specific mastery experiences (TSSME), we collected multidimensional situation-specific data during 2 weeks of practice using PDAs. Going beyond previous studies, we firstly investigated and found variability of TSSME at the teacher, student group and lesson levels. Secondly, we investigated the effects of teacher, student group and lesson characteristics on TSSME, and found teacher level predictors, differential predictors of TSSME at the student group level; stronger effects of student engagement than of student behaviour at the lesson level; and no cross-level interaction effects. We discuss the findings and their implications for educational practice.

Variability of TSSME across teachers, student groups and lessons

In contrast to Hypothesis 1, we found about a quarter of the variance at the teacher level, a quarter at the student group level and about half at the situation level, while Raudenbush et al., (1992) found more than half of the variance between teachers, and Ross et al (1996) more than three quarters. Juxtaposing the findings from our three-level model against that of the two-level models clearly demonstrates that the distinction between person (i.e. teacher), context (i.e. student group) and situation (i.e. lesson) effects is meaningful, supporting calls for studies of this kind (Dellinger et al. 2008; Gibson and Dembo 1984; Tschannen-Moran et al. 1998). As the aim of our study was to focus on situation specificity, our sample of self-selected teachers was not recruited to be representative of the whole teacher population. We also did not restrict the sample to teachers of particular subjects. Hence, we might have underestimated the variance between teachers because they were sampled from only two schools and we possibly did not have enough teachers per teaching subject to be able to detect subject-specific differences in TSSME, rendering us prone to type II errors. Future research studies should take this into consideration in order to differentiate school level effects from student group level effects.

Teacher characteristics and mastery experiences

We found that more experienced teachers, and teachers who had a higher level of domain-specific self-efficacy, reported higher levels of mastery experiences. In line with Hypothesis 2, we found more experienced teacher felt more successful in supporting students and organising the classroom (Gabriele and Joram 2007; Klassen and Chiu 2010). Plausible explanations for this is that more experienced teachers place a greater emphasis on the impact of their teaching, particularly regarding individual differences between students

(Fuller 1969), than on their own adequacy as teachers, whereas the converse is true with novice teachers (Tschannen-Moran and Woolfolk Hoy 2007).

TSE predicted higher levels of success in lessons in line with our proposed cyclical model (Bandura 1997; Bong and Skaalvik 2003), TSE being a predictor of TSSME. While previous studies have shown that adaptive features of teachers' self-beliefs are linked with students' beliefs (Midgley et al. 1989) and adaptive student–teacher interaction (Gibson and Dembo 1984), we specifically found that a higher level of TSE predicted a higher level of success in teaching situations (i.e. fixed effects). An important future task would be to investigate the time period it takes for a teacher to develop a positive cycle of adaptive TSE-TSSME experiences when getting to know a new group of students or alternatively how long it takes for a negative cycle of failure experiences linked with low TSE to develop.

Student group characteristics and mastery experiences

We found student group characteristics, when not controlling for lesson characteristics, to be more predictive of TSSME of organising classrooms than TSSME of supporting learning. Partly in support of Hypothesis 3, a higher TSSME of organising classrooms was predicted by a more (not less), heterogeneous student group performance. We assumed that teaching a heterogeneous student group would be more challenging thus lowering TSSME (e.g. Corno 2008), as a heterogeneous group requires more individualisation and adaptation of the curriculum and tasks to individual students. A plausible interpretation of this finding is that teaching a heterogeneous group is optimally, not excessively challenging, and thus provides impetus for success (Bandura 1997). The effect of group heterogeneity is clearly an important area of future research, as also pointed out by Sharma et al. (2012) and Skaalvik and Skaalvik (2007). TSSME was lower in student groups in which a higher proportion of students were disadvantaged (i.e. eligible for free school meals). As the characteristics of the local school environment of the catchment area are considered beyond the school's or the individual teacher's influence, the finding suggests that disadvantage is indeed perceived as an obstacle to teaching (Tschannen-Moran et al. 1998).

Lesson characteristics and mastery experiences

Teachers felt more efficacious to support learning in active situations (introducing new topics, consolidating and revising) than in assessment situations. These findings could suggest that teachers feel that assessment situations are not optimally challenging while teaching new topics are. In support of Hypothesis 3, we found student engagement to predict a higher level of TSSME in both domains (Raudenbush et al. 1992; Ross et al. 1996). The effect of perceived engagement was stronger than the effect of student behaviour. This finding is important in the UK context, as previous findings have presented behaviour management as the only well addressed aspect of Newly Qualified Teachers' mentoring (Totterdell et al. 2002). In England, professional standards (Department for Education and Skills [DfES] 2002; Department for Education 2011; Training and Development Agency for Schools [TDA] 2009) focus predominantly on competences for organising and structuring the learning environment, rather than the affective aspects of teaching. It has been suggested that more emphasis be given to affective, autonomy supportive and cognitively stimulating aspects of teaching, than focusing almost exclusively on classroom organisation and behaviour management (McNally et al. 2008).

Finally, we tested moderation effects of TSE on the relations between TSSME and lesson and student group characteristics but found no such hypothesized link. Such a link would be expected theoretically, as high-TSE teachers would be able to cope well with momentary drawbacks (Bong and Skaalvik 2003, p. 3). Although the lack of moderation effect in our study could tempt us to conclude that TSE is to some extent invalid as a construct, further replication of this finding is called for. Some previous studies, in which trait TSE was used as an outcome, have found moderation effects. For example, Guo et al (2011) found a moderation effect of teacher collaboration × student engagement such that highly collaborative (as compared to less collaborative teachers) had a higher sense of TSE when dealing with highly engaged children than with less-engaged children.

Limitations and future directions

Three limitations of the present study are obvious. First, we used mastery experiences at the situation level as our dependent variable and TSE as predictor. Future studies could envisage including a situation-specific measure of TSE at say, the end of each working day, or after the end of the collection of situation-specific measures in order to estimate how mastery experiences predict TSE. Another potential dependent variable could be to include fluctuation (i.e. intrapersonal variability) in TSSME in its own right. In line with studies of school-aged children (Musher-Eizenman et al. 2002), it could be hypothesized that teachers with a higher level of TSE would be more stable in their mastery experiences (i.e. exhibit larger autoregressive coefficients) from one situation to another during everyday practice.

Second, we used two items to measure each type of domain-specific mastery experience (Tschannen-Moran and Woolfolk Hoy 2001) and engagement (Fredricks et al. 2004). Although two items provide more information for estimating reliability and structural validity of constructs than single-items do, future studies would need to consider the trade-off between the numbers of items per construct in each situation-specific construct and the time it takes for completing the questionnaire each time (see also Malmberg et al. 2013). Adding more items per construct might enable future researchers to extract three constructs of mastery experiences (Tschannen-Moran and Woolfolk Hoy 2001) and student engagement (Fredricks et al. 2004) consistent with theoretical starting points.

Third, we investigated teachers in only two schools. In order to be able to investigate school level effects on TSSME or any other type of situation-specific belief, affect or perception, teachers from more schools would need to be recruited. In order to establish the effectiveness (i.e. in the sense of "teacher effectiveness") of TSSME on student performance outcomes, data on individual students' prior and subsequent academic performance would also need to be collected.

The main strength of our study is the collection of intensive longitudinal data in the form of lesson reports using PDAs in order to minimise retrospection bias (Carson et al. 2010; Malmberg et al. 2013). Although teachers were reasonably compliant with the research protocol, and with only a few technical problems arising, anecdotal information during data collection suggested that school mainframe computers could be used in future studies. Such studies could indeed allow us to use technological advances (e.g. "apps") for exploring alternative data collection tools which are well-integrated into the everyday practice of teachers. The scope of real-time reporting provides several opportunities to design studies in which sequences of perceptions could be investigated. For example, forethought (e.g. lesson planning), implementation of goals, changes of plans or repair of the course of action

during goal implementation at various time points during the lessons, and how teachers at the end of that lesson evaluate their efficacy for further actions, could be recorded.

In other domains, ambulatory data-recording tools have successfully been used by patients for monitoring health-related issues (Wilhelm et al. 2012). Future software applications could also enable teachers to self-monitor their own collated situation-specific reports (e.g. in the form of a time series chart) on a daily or weekly basis in order to provide information for self-reflection.

Conclusions

Following a cyclical model of teacher self-efficacy and situation-specific mastery experiences, we investigated TSSME for a period of two weeks using electronic questionnaires in PDAs. Two domains of TSSME emerged, successful (motivational and cognitive) support of student learning and classroom organisation. TSSMEs varied between teachers, between student groups and between lessons, differentially predicted by situational (i.e. student engagement), contextual (e.g. student group average attainment) and personal factors (i.e. teaching experience). Overall, our study provides insight into the realm where mastery experiences are shaped or impeded, thus providing a complementary window into teachers' beliefs and perceptions of their practice.

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