Student teachers' peer team teaching experiences from a quantitative perspective: perceptions, profiles and transition probabilities

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A B S T R A C T

Team teaching among student teachers implies more than group composition: the challenge is to teach collaboratively. This quantitative study provides insight into the dynamics of student teachers' perceptions by identifying latent profiles and transition probabilities over time. Therefore, the Student teachers' Team Teaching Perceptions Questionnaire was administered twice during one academic semester to 126 participants. Overall results reveal that student teachers varied in their perceptions. Specifically, latent profile analysis shows that three distinct team teaching profiles emerged at both time points. Moreover, for most student teachers in each of these profiles the initial perceptions remained the same over time.

Keywords: team teaching, student teachers, workplace learning, perceptions, latent profile analysis, latent transition analysis

1. Introduction

Fostering collaborative learning in teacher education is key in supporting student teachers' professional development, as teachers need to be proficient collaborators to successfully perform their job (Vangrieken et al., 2015). For this purpose, teacher education has recently shown a growing interest in team teaching as an innovative model for collaborative workplace learning (Duran et al., 2020; Guise et al., 2017; Härkki et al., 2021; Soslau et al., 2019). In

Flanders (Belgium, i.e., the study site), some universities and colleges have currently included team teaching in the curriculum of their teacher education program (Meirsschaut & Ruys, 2017). By collaborating with peers at the workplace, student teachers can achieve a higher level of performance compared to individual performance and may be better prepared for the transition to practice (Simons et al., 2020) during and after student teaching (Soslau et al., 2019). The term workplace learning is used as a contemporary synonym for internship and refers to the teaching practicum in the field to bridge the theory-to-practice divide (Tynjälä, 2008).

Although team teaching offers a unique context for collaboration and professional development, the engagement of student teachers in team teaching practice is also an essential determinant of effective workplace learning (Billett, 2002; Tynjälä, 2008). According to Gast et al. (2017), multiple individual-level factors can either support or hinder professional development within teams. Therefore, it is crucial to consider student teachers' attitudes toward, motivation to participate in, commitment to and self-efficacy regarding teamwork and the team. Student teachers who lack self-efficacy may be apprehensive about changing their teaching practices. Moreover, student teachers' perceptions of team teaching seem to be related to the team teaching practice. Multiple studies have shown that practitioners' perceptions have positively changed through their experiences with team teaching (Duran et al., 2020; Shin et al., 2016). Conversely, negative experiences can make student teachers less receptive to team teaching (Ongrsquo & Jwan, 2009).

Since team teaching in itself does not necessarily guarantee successful collaboration (Gardiner & Robinson, 2011), it is important to acknowledge the advantages and disadvantages to each practitioner involved. Four crucial advantages of team teaching have been identified in the literature. These include (1) *increased support* for student teachers, (2) opportunities for *dialogue about learning and teaching*, (3) opportunities for *professional growth* in teaching,

collaboration and reflection, and (4) opportunities for student teachers' *personal growth*. In contrast, four crucial disadvantages of team teaching have been recognized as well. These include (1) a *lack of compatibility* between the student teachers in one team (e.g., due to conflicting views or beliefs), (2) the potential for *comparison between peers* (i.e., fear of being outperformed by the other), (3) *difficulty of providing constructive feedback*, and (4) an *increased workload* due to planning, teaching and reflection on lessons together (Baeten and Simons, 2014; De Backer et al., 2021). It is essential to recognize these potential disadvantages as they can influence student teacher outcomes and the overall effectiveness of team teaching (Ronfeldt et al., 2015; Saunders et al., 2009).

Therefore, understanding the dynamics of team teaching in the workplace from the perspective of student teachers is relevant for both student teachers and teacher educators, specifically regarding student teachers' perceptions, profiles and transition probabilities over time. To date, the existing body of research on team teaching has predominantly relied on qualitative methodologies, often constrained by limited sample sizes (Weinberg et al., 2020). Consequently, the current study serves as a valuable complement to the existing literature by employing a quantitative approach with larger sample sizes, thereby making a substantial contribution to the field. In this regard, the four concepts of team teaching (4Cs): *collaboration*, *co-creation*, *coaching* and *complexity*, which include both the advantages and disadvantages mentioned above, provide a useful framework for identifying the elements that shape student teachers' team teaching experiences (De Backer et al., 2021). Hence, this study aims to generate insight into the evolution of student teachers' team teaching experiences related to these 4Cs during workplace learning. To this end, a person-centered approach was adopted to identify distinct heterogeneous groups of individuals. Such approach allows detection of latent profiles (also referred to as classes in the literature) and exploration of transition probabilities (i.e., whether an individual remains in a certain profile or moves to another over time).

The team teaching setting consists of an authentic context within a Flemish College of Education committed to teacher preparation reform. It involves the use of different models of team teaching, with two student teachers being paired as a team teaching duo in a peer-to-peer formation. This study focuses on the first year of team teaching implementation, during which the prerequisites for team teaching were fulfilled. However, no specific support or evaluative feedback was provided on the team teaching itself. Findings of the current study will further insight into the dynamics of student teachers' team teaching perceptions, profiles and transition probabilities during workplace learning.

2. Team teaching within teacher education

In team teaching student teachers work collaboratively in the planning, implementation and evaluation of a course for all learners (Baeten & Simons, 2014), while co-teaching focuses exclusively on learners with special educational needs (Kamens, 2007; Mastropieri et al., 2005). The terms team teaching and co-teaching are often used interchangeably. In the current study, team teaching is referred to as the general concept which includes co-teaching. A key aspect of team teaching is student teachers' focus on their own professional development through reflective dialogue on pedagogical-didactical, interpersonal and normative aspects of their educational practice (Meirsschaut & Ruys, 2017). In doing so, learning issues and goals become more explicit, motivation increases and the capacity to search for answers is reinforced. In addition, collaboration stimulates reflection on experiences. These experiences may form a sound foundation for taking action to improve professional behavior (Van den Bossche et al., 2006).

There is no fixed format for team teaching as it occurs in various collaborative forms, hierarchically outlined by Cook and Friend (1995), adapted by Bacharach et al. (2008), and reviewed by Baeten and Simons (2014). The typology of the latter distinguishes five team

teaching models with increasing levels of collaboration, including: (1) one teach, one observe in the *observation model*, (2) one teach, one coach in the *coaching model*, (3) one teach, one assist in the *assistant teaching model*, (4) both teach in the *equal status model* (parallel teaching, sequential teaching and station teaching), and (5) both teach in full collaboration in the *teaming model*. Regarding the *equal status model*, several teaching formats are possible: teachers split up the class in parallel teaching, divide the learning contents in sequential teaching, or split up both the class and learning contents in station teaching. Overall, each model has a unique purpose with respect to supporting instructional delivery, curriculum learning goals, and classroom environments (Hackett et al., 2019). It should be stressed that there is no such thing as the best model.

Obviously, these models are no simple pedagogical tools one can select and readily apply without any preparation (Rytivaara et al., 2019). When striving for successful implementation in the workplace, various prerequisites are important. A positive relationship between the team-teaching partners, characterized by mutual trust and respect, is key (Chang, 2018; Waber et al., 2022). Also, collaborative planning, communication skills, classroom application, and a knowledge base are considered essential prerequisites (Bacharach et al., 2008; Chang, 2018). Moreover, specific aspects need to be monitored in the context of teacher education. First, student teachers and their team partners should function as equal and shared learners (Guise et al., 2017; Pope-Ruark et al., 2019). Even more so, team teaching mitigates the sharp distinction between novice and experienced (student) teachers (Carambo & Stickney, 2009). Second, team teachers should adopt different roles within a specific model, especially in models where *one teaches* – one team teacher has the lead, to optimize student teachers' learning (Haeck et al., 2013). Third, opportunities to try out different models and to vary between models are important (McCormack et al., 2014; Meirsschaut & Ruys, 2018).

As such, team teaching is a collaborative practice that entails a development trajectory (Härkki et al., 2021; Kim, 2019). Accordingly, some studies point out a growth path that helps student teachers adapt to the team teaching process while developing as teachers. For instance, in the study of Chang (2018) four models with increasing collaboration were applied and evaluated: (1) the *observation model*, (2) the *assistant teaching model*, (3) the *equal status model* of parallel, sequential and station teaching, and (4) the *teaming model*. In line with his results, he suggests a strategy for applying the models in teacher education for both novice and advanced student teachers. First, in early workplace learning the use of the *observation model* and the *assistant teaching model* can help novice student teachers familiarize with the routines of the classroom. Next, student teachers can assume more responsibility in later workplace learning with the *equal status model* of station teaching and sequential teaching. Finally, advanced student teachers can expand their team teaching practices with the more challenging models of the *equal status model* of parallel teaching and the *teaming model*.

3. Concepts of team teaching

To investigate team teaching, it is important to clarify the 4Cs of *collaboration*, *co-creation*, *coaching*, and *complexity*. These concepts are composed based on the above mentioned advantages and disadvantages of team teaching (a more detailed explanation is given in De Backer et al., 2021). First, the concept of *collaboration* is defined by Vangrieken et al. (2015) as "… joint interaction in the group in all activities that are needed to perform a shared task" (p. 23). They also put forward that the concept is not static and uniform but rather exists along a continuum, with different types of collaboration occurring at varying depths. At one end of the continuum, there are 'mere aggregates of individuals,' which refers to individuals who lack interdependence and have limited team commitment. At the other end of the continuum, there is 'strong team collaboration'. In addition, collaboration involves the aspect of support by means

of positive feelings and social cohesion (Chang & Bordia, 2001). The latter refers to the nature and quality of the emotional bonds of friendship (Van den Bossche et al., 2006). Then, collaboration between team teachers should be based on pursuing mutual goals, assuming mutual responsibility, sharing accountability for outcomes, and the development of trust and respect (Cook & Friend, 2010; Jortveit & Kovač, 2021).

Next, the concept of *co-creation* is also referred to as co-construction in empirical research on team learning. Researchers such as van der Haar et al. (2015) define co-construction as "… a process in which team members share facts they know and ideas they have and build meaning by refining, building on, or modifying the original input; it facilitates the exchange of information and ideas. Being an interaction process, co-construction incorporates process behaviors such as describing the problem situation, sharing information and ideas, active listening and tuning into other team members, and trying to grasp explanations and intentions" (p. 58).

Further, central to the concept of *coaching* is good support of the other team teacher to increase self-confidence and motivation. The challenge exists in achieving mutual understanding of team teaching and the corresponding team roles (Darragh et al., 2011), as the latter promote team cohesion and responsibility (Kirschner et al., 2018). Last, the concept of *complexity* can be understood as referring to the following disadvantages, retrieved from the literature: (1) lack of compatibility between peers, (2) comparison between peers, (3) difficulty of providing constructive feedback, and (4) increased workload (Baeten and Simons, 2014; De Backer et al., 2021).

In brief, the 4Cs highlight the key elements of team teaching which may be perceived as advantageous or disadvantageous by student teachers. The idea is that more advantageous partnerships improve teaching, increase motivation and provide more expertise (Jortveit & Kovač, 2021). It is expected that the personal team teaching experiences of student teachers

will differ, since the study of Härkki et al. (2021) pointed out imbalanced co-operation, collaboration, and highly functional collaboration as three different partnership performances of team teaching.

4. Research questions

In the field of education, specifically in teacher education, the focus on team teaching as a collaborative model is relatively recent. However, much research has already been done in the special education domain (Bacharach et al., 2010). In contrast, research in student teaching appears to be a new field of study (Stapleton et al., 2021). Indeed, research on the practice of team teaching by student teachers is limited (Simons et al., 2020), as capturing student teachers' learning process is complex from a methodological perspective. To the best of our knowledge, no research has investigated the dynamics of student teachers' perceptions on peer team teaching from a quantitative perspective. The current study aims to fill this gap by exploring student teachers' perceptions of team teaching and the extent to which these perceptions change as a result of extended peer team teaching experiences involving the application of different team teaching models. For this purpose, student teachers' perceptions were measured at two specific time points: during and after workplace learning. Hence, the following three research questions are central to this study:

RQ1: *How do student teachers experience team teaching related to the 4Cs over time?*

RQ2: *Are there profiles of student teachers with similar patterns of scores on the 4Cs at time point 1 and time point 2 (RQ2a)? If so, how can these profiles be typified (RQ2b)?*

RQ3: *Are student teachers classified into the same profiles at each time point or do they make a transition to another profile?*

5. Methodology

5.1.   Context and participants

The current study was conducted within a three-year teacher education program in Flanders, designed to prepare students for a bachelor's degree in primary or lower secondary education. A total of 181 participating student teachers were prepared for their new role (i.e., knowledge and skills related to team teaching) before applying team teaching with a peer student teacher. During the workplace learning period in the second semester of the academic year, student teachers were assigned to implement three different team teaching models. These models were selected based on the growth path sequence and included: (1) the *observation model*, (2) the *assistant teaching model*, and (3) the *equal status model* of station teaching and parallel teaching. The teaming model was intentionally omitted due to its complexity, as it requires the highest level of collaboration, and considering the limited time available for workplace learning in the second semester.

The ten days of workplace learning were divided into three periods: (1) a one-day period in February, (2) a two-day period in April and (3) a seven-day period in March. Throughout these periods, student teachers taught a total of 30 lessons, with sixteen lessons dedicated to team teaching: (1) eight times the *observation model*, (2) four times the *assistant teaching model* and, (3) four times the *equal status model* of station teaching and parallel teaching. In the application of the *observation model*, each team teacher observed four lessons and provided feedback to their partner team teacher. Next, during the lessons according to the *assistant teaching model*, each team teacher performed two lessons as the main teacher (with the other partner assisting) and two lessons as the assistant (while the other partner was teaching). Subsequently, in the implementation of station teaching, the class was divided into subgroups and each team teacher taught different learning content to a subgroup, followed by subgroup rotation. Finally, in the practice of parallel teaching, the class was divided into subgroups and

each team teacher delivered the same learning content to a subgroup of pupils. Pairs of student teachers were randomly assigned to a school (Walsh & Elmslie, 2005).

5.2.   Instrument

A crucial aspect of student teaching experience involves the evaluation of student teachers and the assessment tools employed for this purpose (La Paro et al., 2014). However, deficiencies in program practices concerning the provision of support and evaluative feedback during the teaching experiences of student teachers have been observed as well (Stapleton et al., 2021). These findings suggest that current program practices may not adequately address the needs of student teachers in terms of support and evaluative feedback during their teaching trajectory. In this respect, the Student teachers' Team Teaching Perceptions Questionnaire (STTPQ), with 29 items in the 4Cs, is a valid and reliable tool for teacher education that aims to work data-driven for capturing the process of team teaching as a function of support and evaluative feedback (De Backer et al., 2021; see Appendix A, available with the online version of this article).

The STTPQ was administered twice: at time point 1 (T_1) during workplace learning (after day three) and at time point 2 (T_2) after workplace learning (after day ten). All 29 items were measured on a 5-point Likert scale ranging from *I totally disagree* (1) to *I totally agree* (5). Example items for the scale collaboration (*n* = 5 items) are *I could rely on my team-teaching partner for questions and concerns* or *I got along very well with my team-teaching partner.* Next, example items in the co-creation scale (*n* = 10 items) are *I had enough possibilities to share my teaching experiences with my team-teaching partner* or *I regularly exchanged information with my team-teaching partner.* Further, the scale for coaching (*n* = 7 items) includes items such as *I felt more confident thanks to the presence of my team-teaching partner during the lessons* or *Teaching the lessons alongside my team-teaching partner made me feel at ease.* Last, the scale for complexity (*n* = 7 items) includes items such as *The workload for a*

team taught lesson was high or *The comparison between my team teaching partner and I (e.g., by pupils, by the mentor) bothered me.*

5.3.   Analyses

In total, 181 student teachers responded to the survey at T_1 and 69.6% of them completed both questionnaires at T_1 and T_2, which corresponded to a final sample of 126 student teachers. Missing data was due to both item and individual non-response. To prepare the data, the 4Cs of team teaching were computed by averaging the items for each participant, with a required minimum of two completed items for each scale at each time point. Furthermore, to assess the reliability, the Cronbach's alpha parameters ($\alpha < 0.60$ = bad; $0.60 \leq \alpha < 0.80$ = reasonable; $\alpha \geq 0.80$ = good) were calculated to verify the internal consistency of the 4Cs (Creswell, 2002). Analysis for each RQ will be sequentially and separately described below.

In order to map student teachers' perceptions on the 4Cs of team teaching over time (**RQ1**), descriptive statistics – mean and standard deviation – and paired t-tests with the software program Rstudio were conducted (De Maeyer et al., 2012). In the interpretation of the mean score, scores above 3.50 (on 5) were considered high, scores between 2.50 and 3.50 average and scores below 2.50, low. These intervals are based on similar criteria used in a previous study on student teachers' team teaching perceptions with similar items (Simons et al., 2020). Furthermore, the use of effect sizes, specifically paired Cohen's d, was adopted to assess practical significance (Cohen, 1988). In terms of interpretation, paired Cohen's d values can be considered very small (0.00-0.19), small (0.20-0.49), medium (0.50-0.79) or large (0.80+).

Subsequently, to explore the extent to which student teachers can be identified in latent profiles of people who share commonalities in aspects of their team teaching perceptions (**RQ2a**), person-centered mixture models in M*plus* version 8.5 (Muthén & Muthén, 1998-2017) were generated by using latent profile analysis (LPA). An important advantage of LPA is its superiority over traditional cluster analyses (e.g., k-means clustering, hierarchical clustering) in

detecting latent taxonomy as it is model-based.[1] In conducting LPA, models with incremental numbers of latent profiles (e.g., one, two, three and four profiles) were estimated to identify the number of profiles that best fitted the observed data. For this purpose, a set of fit indices was inspected, including the *Bayesian Information Criterium (BIC), sample-size-adjusted BIC* (*SABIC*), the Bootstrap Likelihood Ratio Test (BLRT), the *Lo–Mendell–Rubin Likelihood Ratio Test* (*LMR-LRT*) and the Entropy Test (Ferguson et al., 2020). Additionally, substantive considerations were made to ensure interpretability (e.g., meaningful profiles, sufficiently representative). For the analyses, the means of the profile indicators were allowed to vary across the profiles while constraining the variances to be equal across profiles and permitting no residual covariances. A more detailed practical guide of LPA is given in Johnson (2021) and Spurk et al. (2020). Next, regarding typifying the retained profiles (**RQ2b**), the means of the 4Cs and proportions for each profile at each time point were estimated and compared.

Finally, as an extension of LPA, latent transition analysis (LTA) in M*plus* version 8.5 (Muthén & Muthén, 1998-2017) was conducted to estimate at both time points, k latent profiles (from repeated measures of the 4Cs at T_1 and T_2) as well as the probabilities to transition from profiles in C_{k1} to profiles in C_{k2} over time (**RQ3**; see Figure 1).[2] The latent profiles, denoted as "C," represent subgroup memberships at a specific point in time. The symbol "k" refers to the number of profiles, while "1" or "2" indicates the respective time point.

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[1] For an overview of the method see Pastor et al. (2007) and Vermunt and Magidson (2002).
[2] For a clear overview of the method see Hofmans et al. (2020), Johnson (2021) and Nylund (2007).
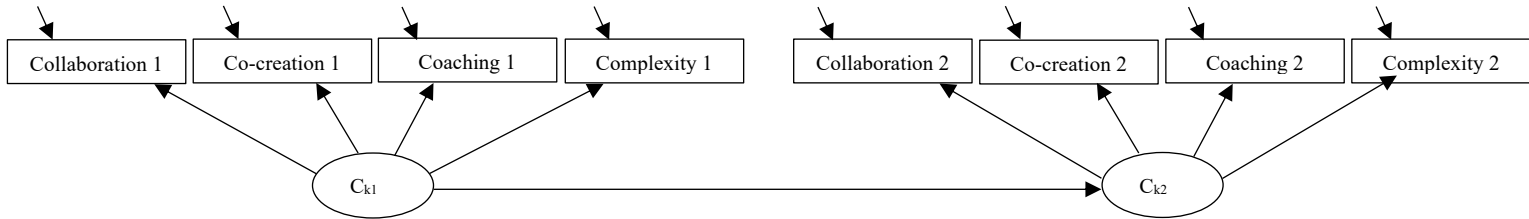
Figure 1. Latent transition model with four observed continuous variables at two time points.
Note. $C_{k1} \rightarrow C_{k2}$ = latent profiles over time.

6. Results

6.1. Student teachers' perceptions of team teaching over time (RQ1)

Differences in student teachers' team teaching perceptions of the 4Cs at each time point, as well as the reliability of each scale were estimated. The latter shows that the internal consistency of all scales was reasonable to good. Furthermore, results in Table 1 show that, at T_1, student teachers adopted positive perceptions related to collaboration ($M = 4.04$, $SD = 0.84$, $\alpha = 0.89$), co-creation ($M = 3.72$, $SD = 0.68$, $\alpha = 0.88$) and coaching ($M = 3.50$, $SD = 0.70$, $\alpha = 0.84$), as all the mean scores were equal to or above 3.50. In line with these high scores, student teachers' perceptions related to complexity were average ($M = 2.61$, $SD = 0.61$, $\alpha = 0.71$).

At the end (day 10) of collaborative workplace learning (T_2), student teachers' perceptions related to collaboration ($M = 3.94$, $SD = 0.96$, $p = .08$, $\alpha = 0.93$) and co-creation ($M = 3.63$, $SD = 0.76$, $p = .10$, $\alpha = 0.90$) decreased, but remained at a high level and showing very small effect sizes ($d_{paired} = 0.16$ and 0.15, respectively). Next, perceptions related to coaching significantly decreased to an average score ($M = 3.23$, $SD = 0.79$, $p = .01$, $\alpha = 0.87$ and showing a small effect size ($d_{paired} = 0.45$). Meanwhile, perceptions related to complexity

significantly increased, but remained average ($M = 2.73$, $SD = 0.63$, $p = .01$, $\alpha = 0.71$), with a small effect size ($d_{paired} = 0.23$).

In brief, these findings reveal that student teachers perceived slightly less *collaboration* and *co-creation*, and significantly less *coaching*, in contrast to significantly more *complexity* over time.

Table 1

Repeated measures of student teachers' team teaching experiences

	Time point 1		Time point 2				
	M	*SD*	*M*	*SD*	*t*	*p*	d_{paired}
Collaboration	4.04	0.84	3.94	0.96	1.77	.08	0.16
Co-creation	3.72	0.68	3.63	0.76	1.66	.10	0.15
Coaching	3.50	0.70	3.23	0.79	5.07	.01	0.45
Complexity	2.61	0.61	2.73	0.63	-2.59	.01	0.23

Note. n = 126.

6.2. *Profiles of student teachers on the 4Cs at both time points (RQ2a)*

Next to mapping student teachers' team teaching perceptions over time, student teachers' individual differences in team teaching perceptions were estimated at each time point in order to determine underlying homogeneous groups of students with the same profile. Table 2 presents the fit indices and the smallest profile percentage of the models with one up to four latent profiles for T_1 and T_2 separately. The 5-profile model was excluded in the table as a possible solution because the smallest profile appeared underrepresented (i.e., insufficient class proportion) with too few participants. In deciding which model was the best for each time point separately, both statistical and theoretical considerations were investigated.

First, at T_1 an increase in the number of profiles implied a decrease in the BIC and SABIC, leaving no solution. Also, the *p*-value of the BLRT indicated that a model with more

profiles remained significant ($p < .05$). On the contrary, the p-value of the LMR-LRT suggested a 3-profile model as the 4-profile model was not significantly better ($p = .26$). Moreover, the highest Entropy of .888 and the 11.70% smallest profile percentage also suggested the 3-profile model. Consequently, the 3-profile model – supported by the p-value of the LMR-LRT, Entropy and smallest profile percentage – was chosen as the best solution for T_1.

Second, at T_2 both the BIC (starting from the 1-profile model) and the SABIC (starting from the 2-profile model) constantly decreased with an increase in the number of profiles, leaving no suggestion. Nor did the p-value of the BLRT point to a better model as a model with more profiles was shown to remain significant ($p < .05$). Nonetheless, the p-value of the LMR-LRT supported the 3-profile model, which became insignificant ($p = .20$) at the 4-profile model. On the contrary, the highest Entropy of .912 was shown for the 4-profile model. However, inspection of the smallest profile showed an overextraction of the four profiles (6.98%), which was not the case for the 3-profile model (15.25%). Therefore, the 3-profile model – supported by the p-value of the LMR-LRT and the smallest class percentage – was chosen as the best solution for T_2.

In sum, the 3-profile model was retained for T_1 as well as for T_2, meaning that the profiles are the same across the different time points, implying a full measurement invariance (Nylund, 2007) and no label switching (Collins & Lanza, 2009).

Table 2

Fit indices of the different profile-models at the two time points

	Time point 1					
Model	BIC	SABIC	*p* BLRT	*p* LMR-LRT	Entropy	Smallest profile
1-profile	1108.54	1083.24				
2-profile	973.36	932.25	<.001	.01	.887	25.69%
3-profile	920.26	863.34	<.001	.02	.888	11.70%
4-profile	908.03	835.30	<.001	.26	.855	9.10%
	Time point 2					
Model	BIC	SABIC	*p* BLRT	*p* LMR-LRT	Entropy	Smallest profile
1-profile	1207.71	1182.42				
2-profile	1065.77	1224.66	<.001	<.001	.948	18.37%
3-profile	993.79	936.87	<.001	.03	.880	15.25%
4-profile	982.86	910.13	<.001	.20	.912	6.98%

Note. BIC = Bayesian Information Criteria, SABIC = sample size adjusted Bayesian Information Criteria, *p* BLRT = *p*-value of the Bootstrap Likelihood Ratio Test, *p* LMR-LRT = *p*-value of the Lo–Mendell–Rubin Likelihood Ratio Test.

6.3.   *Types of profiles (RQ2)*

Both 3-profile models consisted of distinct (i.e., sufficiently large) and interpretable (i.e., meaningful) profiles that reflected a clear classification of student teachers based on their perceptions of team teaching. For each profile of the 3-profile model the means and proportions were estimated for each time point. In doing so, the profiles could be typified and labelled uniformly for both time points as: (Profile 1) *negative perceptions*, (Profile 2) *moderate perceptions* and (Profile 3) *positive perceptions*. Figure 2 and Figure 3, as shown below, visualize the estimated means and proportions of the three profiles for T_1 and T_2 respectively: Profile 1 stands for *negative perceptions*, Profile 2 for *moderate perceptions* and Profile 3 for *positive perceptions*.

During workplace learning a minority of student teachers (11.70%) could be typified as the group with *negative perceptions* on team teaching because they reported the lowest scores

for collaboration ($M = 2.35$), co-creation ($M = 2.45$), and coaching ($M = 2.72$) and the highest scores for complexity ($M = 2.82$). Next, the *moderate perceptions* profile was presented by a larger group of student teachers (36.78%). These students reported higher scores for collaboration ($M = 3.71$), co-creation ($M = 3.45$), and coaching ($M = 3.20$) and lower scores for complexity ($M = 2.70$). A majority of student teachers (51.53%) belonged to the *positive perceptions* profile. These students gave high scores to scales collaboration ($M = 4.66$), co-creation ($M = 4.20$), and coaching ($M = 3.90$) and low scores on the complexity scale ($M = 2.51$).

Although the same profiles were maintained after workplace learning (T_2), the means differed slightly, and the class proportions altered. The minority of student teachers (15.25%) were still classified into the *negative perceptions* profile as they reported the lowest scores for collaboration ($M = 2.20$), co-creation ($M = 2.34$), and coaching ($M = 2.17$) and the highest scores for complexity ($M = 2.86$). In contrast to T_1, the largest group of students (55.87%) did not belong to the *positive perceptions* but to the *moderate perceptions* profile with moderate scores for collaboration ($M = 3.95$), co-creation ($M = 3.59$), coaching ($M = 3.12$) and complexity ($M = 2.82$). After workplace learning, the third profile, i.e., *positive perceptions* only included 28.88% of the student teachers, characterized by the highest scores for collaboration ($M = 4.85$), co-creation ($M = 4.40$), and coaching ($M = 4.02$) and lowest scores for complexity ($M = 2.49$).
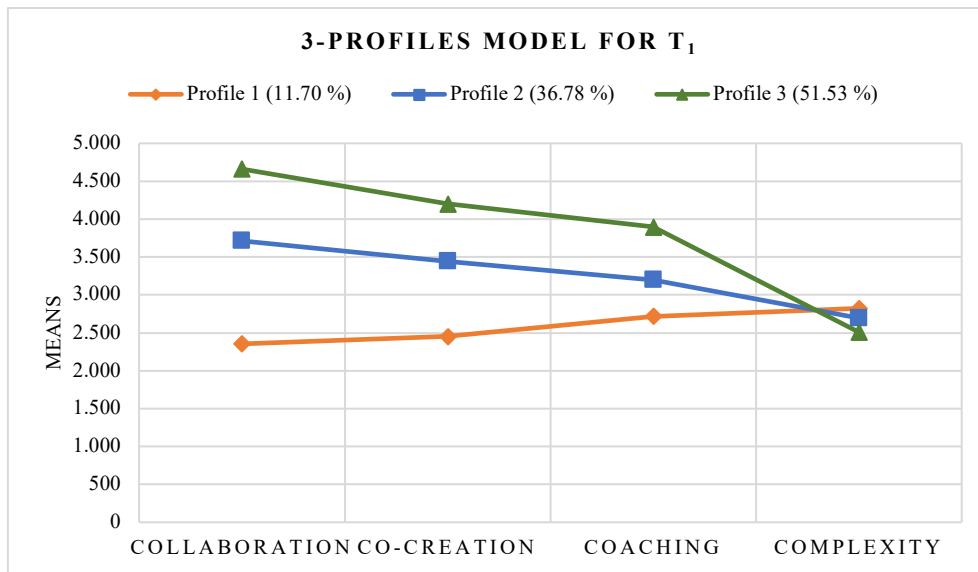
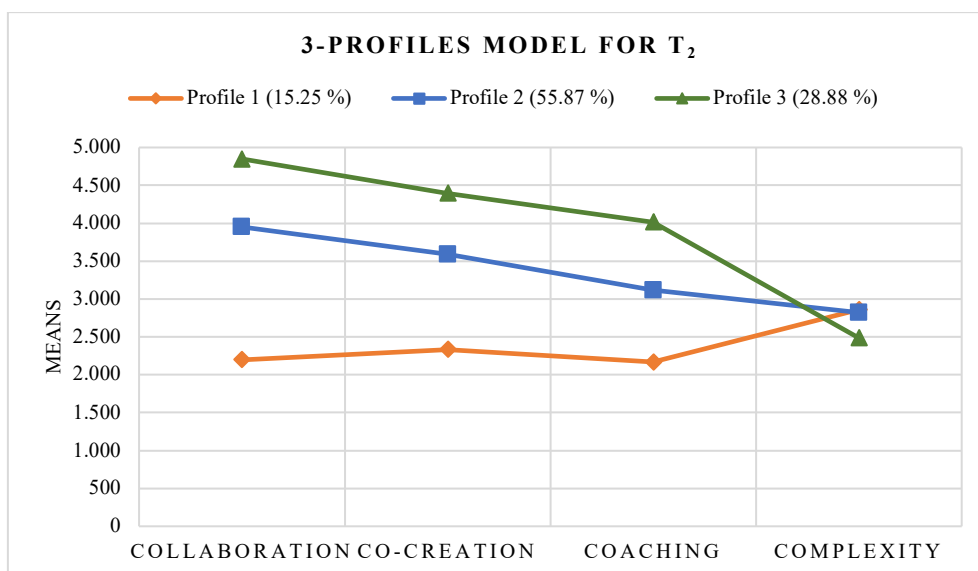**Figure 2.** Estimated means and proportions of the three profiles at time point 1.

Figure 3. Estimated means and proportions of the three profiles at time point 2.

6.4.   *Transition probabilities of student teachers (RQ3)*

In order to estimate the transition probabilities – remaining in or moving to a certain profile – of student teachers, the two 3-profile models were linked together across both time points into an LTA model. Given the similar mean scores in each profile at each time point as outlined above, the LTA model was estimated by constraining the means of the three profiles to be equal

at T_1 and T_2. Table 3 shows the results of the profile proportions at each time point as well as the latent transition probabilities based on the estimated model.

Table 3

Profile proportions at each time point and latent transition probabilities across time points

	T_2 profile 1 (16.41%)	T_2 profile 2 (48.13%)	T_2 profile 3 (35.46%)
T_1 profile 1 (11.77%)	.92	.08	.00
T_1 profile 2 (41.18%)	.11	.83	.06
T_1 profile 3 (47.05%)	.03	.28	.70

Note. Profile 1 = negative perceptions, profile 2 = moderate perceptions, profile 3 = positive perceptions.

First, the *negative perceptions* profile included a greater percentage of student teachers at T_2 (16.41%) compared to T_1 (11.77%). Specifically, the majority of student teachers (92%) remained in the same profile, were least likely (8%) to move to the *moderate perceptions* profile and did not move to the *positive perceptions* profile (0%). Even though some student teachers upgraded to the *moderate perceptions* profile, the vast majority of student teachers retained their negative perceptions.

Second, results indicate that the *moderate perceptions* profile at T_2 (48.13%) included more student teachers compared to T_1 (41.18%). Specifically, student teachers most likely (83%) remained in the same profile, were less likely (11%) to move to the *negative perceptions* profile and exceptionally (6%) moved to the *positive perceptions* profile. Despite these transitions to both less and more positive profiles, most student teachers maintained their *moderate perceptions* during workplace learning.

Third, in contrast to the previous profiles, the *positive perceptions* profile contained less student teachers at T_2 (35.46%) than T_1 (47.05%). These student teachers most likely (70%) remained in the same profile, were less likely (28%) to move to the *moderate perceptions* profile and least likely (3%) to move to the *negative perceptions* profile. Although most student

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teachers stayed in their initial profile of *positive perceptions*, a large percentage (approximately 30%) degraded to the *moderate perceptions* profile.

7. Discussion

Understanding the dynamics of student teachers' peer team teaching perceptions is essential for supporting their professional development, since the collaborative setting of team teaching does not in itself guarantee successful collaboration (Gardiner & Robinson, 2011). The current study explored student teachers' perceptions of peer team teaching and the extent to which these perceptions change during collaborative workplace learning. In this respect, perceptions refer to how student teachers feel or think about team teaching in terms of collaboration, co-creation, coaching and complexity, referred to as the 4Cs (De Backer et al., 2021). Findings suggest that student teachers hold different personal beliefs, as they vary in their team teaching perceptions regarding the 4Cs. By describing three distinct team teaching profiles at two time points together with transition probabilities, this study provides insight into the dynamic team teaching perceptions of student teachers.

Findings reveal that student teachers generally adopted positive perceptions during collaborative workplace learning, particularly related to collaboration, co-creation and coaching. However, their perceptions of the complexity of team teaching were found to be moderate. Furthermore, results indicate that at the end of collaborative workplace learning, student teachers maintained positive perceptions related to collaboration and co-creation with their peers. In contrast, they reported slightly less positive feelings related to coaching and experienced a greater sense of complexity when engaged in team teaching. This finding is important as it suggests a change in the perception of student teachers when progressing in their workplace learning. The decrease in perceived coaching may possibly be attributed to the transition from the assistant teaching model to the relatively less coaching-oriented equal status model of station teaching and parallel teaching. The former emphasizes mutual support, while

the latter focuses on sharing equal classroom responsibilities (Baeten & Simons, 2014; Chang, 2018). Another plausible explanation could be that student teachers may not have possessed sufficient skills to effectively act as coaches for their peers (Eriksen et al., 2020). The increase in perceived complexity may indicate a growing sense of difficulty as the team teaching models become more intricate to execute (Chang, 2018). This finding aligns with the study conducted by Simons et al. (2020), where student teachers expressed hesitations about parallel teaching due to organizational challenges following their field experiences. Overall, student teachers perceived team teaching as a valuable professional practice, which is consistent with the study of Darragh et al. (2011).

However, a more detailed exploration of these positive perceptions was prompted. In pursuit of profiling student teachers with similar patterns of scores on the 4Cs at both time points, three team teaching profiles emerged. First, the minority of student teachers both during and after workplace learning were classified in the *negative perceptions* profile, since for these student teachers the disadvantages outweighed the advantages. Second, during workplace learning, the majority of student teachers belonged to the *positive perceptions* profile, since these student teachers reported many advantages and few disadvantages. Finally, after workplace learning, most student teachers were classified in the *moderate perceptions* profile, since these students still reported some advantages but experienced some disadvantages as well. These findings are intelligible, given all the difficulties of team teaching as an innovative collaborative model for workplace learning (Guise et al., 2017).

The qualitative study conducted by Härkki et al. (2021) provides insights into similar profile patterns within the context of co-teaching among in-service teachers at the team level. Their research identifies three distinct partnership performances: (1) imbalanced cooperation, (2) collaboration, and (3) highly functional collaboration. The imbalanced cooperation, defined by perfunctory co-teaching, corresponds to the *negative perceptions* profile. This profile is

marked by a lack of collaboration, co-creation, and coaching, accompanied by an augmented sense of complexity. Collaboration, on the other hand, signifies effective co-teaching comparable to the *moderate perceptions* profile. It entails substantial levels of collaboration, co-creation, and coaching while maintaining a moderate level of complexity. Lastly, highly functional collaboration aligns with the *positive perceptions* profile. Within this profile, there are heightened levels of collaboration, co-creation, and coaching, complemented by minimal complexity.

The nomenclature used to label the profiles in Härkki et al.'s (2021) study can similarly be adopted in the current study, labeling the profiles as *non-functional team teaching*, *functional team teaching*, and *highly functional team teaching* for the negative perceptions, moderate perceptions, and positive perceptions profiles, respectively. This type of profiling not only contributes to a more comprehensive framework for understanding the dynamics of team teaching but also facilitates custom support and evaluative feedback strategies when practicing peer team teaching (Stapleton et al., 2021). Furthermore, it allows further inspection of which individual factors – attitude, motivation, commitment, and self-efficacy – hinder or facilitate the team teaching practice (Gast et al., 2017). For example, student teachers in the *non-functional team teaching* profile might be in greater need of support and evaluative feedback compared to their peers in the *functional team teaching* and *highly functional team teaching* profiles because they feel less committed to their team partner.

Moreover, in examining the transition probabilities of student teachers remaining in or moving to a certain profile over time, a clear pattern emerged. Results indicate that the vast majority of student teachers in each of the three profiles did not make the transition to another profile but instead remained in the same profile. However, the few student teachers who did make a transition tended to degrade to a less positive profile. One possible explanation for this pattern is that the challenges posed by the increasingly complex team teaching models offset

the benefits gained from increased experience in team teaching. Furthermore, it should be emphasized that the period between T_1 and T_2 was relatively short, so it was expected that not all student teachers' perceptions would change. Additionally, the number of transitions also depends, to a certain extent, on the number of extracted profiles. If, for example, the fit indices had shown that four profiles better fitted the data than three, the number of transitions would probably have been higher. This finding is relevant, given that teacher education aims to provide all student teachers with the best support and evaluative feedback, including the few whose team teaching trajectory is difficult from the start or during the process, so everyone can experience success (La Paro et al., 2014; Stapleton et al., 2021).

7.1. *Implications for teacher education*

In line with previous studies (Duran et al., 2020; Shin et al., 2016), it was expected that student teachers' perceptions would change positively by practicing team teaching. However, our findings show that offering student teachers experiences of team teaching is not in itself sufficient to enhance the perceptions toward collaboration, co-creation and coaching. Even more, the latter seems to be a hurdle for student teachers, which might indicate that the challenges posed by increasingly complex team teaching models offset the benefits gained from increased experience in team teaching. Relatedly, student teachers might also benefit from training in the necessary skills to coach their peer partner (Eriksen et al., 2020). Furthermore, our findings also show that the team teaching trajectory involves a certain degree of complexity for student teachers, possibly due to the inclusion of more complex team teaching models. This emphasizes the dual importance of fulfilling the prerequisites when implementing team teaching (Meirsschaut & Ruys, 2018), as well as detecting the difficulties of team teaching during its execution (Stapleton et al., 2021).

7.2.   Implications for research

This study contributes valuable insights to the field of collaborative workplace learning, specifically in the context of team teaching. However, it is important to acknowledge the limitations of this study and explore potential avenues for future research. First, a primary limitation of this study is the relatively small sample size in relation to conducting an LPA/LTA. Conducting latent profile analysis (LPA) and latent transition analysis (LTA) with a sample size of less than 250 participants may restrict the generalizability of the results and reduce the statistical power. Additionally, the small sample size may impede reliability and validity assessment of the identified latent profiles and transitions. Therefore, the results should be interpreted with caution and further research with larger sample sizes (> 250) is recommended to confirm our findings. Second, it is important to note that the unit of analysis in this study was individuals. However, future quantitative research on team teaching is encouraged to broaden its scope and shift the focus towards partnerships as the primary unit of analysis. By delving into the dynamics and interactions within these partnerships, researchers can gain a more comprehensive understanding of the collaborative learning process in team teaching.

8. Conclusions

While teacher education institutes set the context of collaborative workplace learning by implementing team teaching, it remains a reciprocal interaction between the student teacher and the workplace, implying that the student teacher chooses to what extent they engage in activities provided by the workplace (Billett, 2002; Tynjälä, 2008). This is reflected in the variety of team teaching profiles: non-functional, functional or highly functional. It confirms the importance of early detection and follow-up of difficulties during student teachers' team teaching practice, in order to provide them custom support and evaluative feedback (La Paro et al., 2014; Stapleton et al., 2021), so that they remain in or move to the highly functional profile. Moreover, considering that the vast majority of student teachers in each of the three profiles remained in

the same profile, possibly due to the increased complexity of the team teaching models, it is essential to consider the various prerequisites when implementing team teaching for a successful trajectory (Meirsschaut & Ruys, 2018). This approach allows for the exploration of its advantages and the promotion of (highly) functional collaboration (Bush & Grotjohann, 2020). The underlying idea is that beneficial partnerships, such as the functional and highly functional profiles, improve teaching, increase motivation and provide more expertise (Jortveit & Kovač, 2021).

Ethics

The authors report no conflicts of interest. The Ethics Committee for the Social Sciences and Humanities of the University of Antwerp approved this study.

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Declaration of competing interest

The authors report no conflict of interest.

Data availability

Data will be made available on request.

Appendix A.

STTPQ

No.	Item	Scale
1	I could rely on my team-teaching partner for questions and concerns.	Collaboration
2	My team-teaching partner gave me professional support (e.g. ideas, useful information).	Co-creation
3	I felt as if there was competition between my team-teaching partner and I.	Complexity
4	I was concerned that my team-teaching partner would teach better than me.	Complexity
5	Teaching the lessons alongside my team-teaching partner made me feel at ease.	Coaching
6	By reflecting on the lessons with my team-teaching partner, I gained more insight in my own qualities as a teacher.	Co-creation
7	I had enough possibilities to share my teaching experiences with my team-teaching partner.	Co-creation
8	The team-teaching activities required hard work.	Complexity
9	I learnt a lot by preparing the lessons with my team-teaching partner.	Co-creation
10	My team-teaching partner and I complemented each other very well.	Collaboration
11	The collaboration with my team-teaching partner was efficient.	Collaboration
12	I felt more motivated during the team-teaching activities.	Coaching
13	I felt more confident thanks to the presence of my team-teaching partner during the lessons.	Coaching
14	During the team-teaching activities I had to memorize many things at once.	Complexity
15	Without the presence of a team-teaching partner, I feel more comfortable.	Coaching
16	During the team-teaching activities I had to make difficult decisions.	Complexity
17	The workload for a team-taught lesson was high.	Complexity
18	I regularly exchanged information with my team-teaching partner.	Co-creation
19	I got along very well with my team-teaching partner.	Collaboration
20	My team-teaching partner was a source of information.	Co-creation

21	Thanks to the collaboration with my team-teaching partner, I reflected better on what does and what does not work.	Co-creation
22	My team-teaching partner gave me emotional support (e.g. encouragements, a listening ear).	Collaboration
23	The presence of my team-teaching partner made me feel more at ease.	Coaching
24	By preparing our lessons together, we dared to try out new things.	Co-creation
25	I felt more secure by preparing the lessons together.	Coaching
26	I would have felt less anxious if I only had to give individual lessons.	Coaching
27	My team-teaching partner gave me useful feedback on my lessons.	Co-creation
28	The comparison between my team-teaching partner and I (e.g. by pupils, by the mentor) bothered me.	Complexity
29	During the team-teaching activities I felt competent to teach.	Co-creation

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