Chapter

Let's Team Up! Measuring Student Teachers' Perceptions of Team Teaching Experiences

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Abstract

Since collaboration within schools gains importance and is considered significant for teachers' professional development in order to meet the new 21st-century educational demands, teacher education institutes show a growing interest in field experiences inspired by collaborative learning, such as team teaching. Team teaching is a teaching model in which (student) teachers work collaboratively in the preparation, teaching and evaluation of a course. In order to assess team teaching practices in teacher education by monitoring perceptions of collaborative team teaching experiences, an instrument is needed that offers insights to guide the learning process and support well-founded decision making. Therefore, an easy-to-use quantitative questionnaire to explore student teachers' team teaching perceptions was developed and validated in four stages: an extensive literature review (1) resulting in a preliminary questionnaire containing advantages and disadvantages of team teaching (2). Next, a pilot study was conducted with 14 student teachers (3), followed by a further validation and reliability study based on exploratory factor analysis, peer debriefing, confirmatory factor analysis and internal consistency analysis with 181 participating student teachers (4). The final questionnaire comprises 29 Likert-items in four scales – *collaboration*, *co-creation*, *coaching* and *complexity* – and appears to be both valid and reliable.

Keywords: teacher education, field experiences, collaboration, team teaching, student teacher, perceptions, questionnaire development, questionnaire validation

1. Introduction

1.1 Collaborative teaching in teacher education

Within teacher education, field experiences are crucial in the training of future teachers [1] as they trigger learning [2]. During field experiences, student teachers are traditionally placed individually with a mentor [3], i.e., the teacher in whose classroom the internship is conducted. They start by observing their mentor and, afterwards, get the responsibility to take over the class *individually* during a number of hours [4, 5].

However, theories of cooperative learning [6] and team learning [7] underline that professional cooperation can be highly beneficial. Indeed, collaboration between teachers is significant for their professional development [8] in order to meet the new educational demands of the 21st century [9, 10]. It triggers processes

of making learning questions and goals more explicit, leads to increased motivation, and reinforces the capacity to search for answers. Moreover, it stimulates reflection on experiences as a basis to undertake action to improve professional behavior [11].

Furthermore, both schools and policy makers are seeking teaching models in which teachers are more committed to collaborating, sharing expertise and experiences, supporting each other, learning collaboratively, and enhancing their own competencies [12–14]. Those collaborative models can enhance learning by assisting teachers in responding better to learners' needs through, for example, differentiated instruction, and potentially result in improved learning outcomes [15, 16].

Consequently, since collaboration within schools gains importance and is considered significant for teachers' professional development, teacher education institutes show a growing interest in field experiences inspired by collaborative learning [17]. By collaborating with peers, student teachers can reach higher levels of performance [18]. Moreover, it may help student teachers to be better prepared for the transition to practice [19]. By hosting student teachers in pairs, opportunities for team teaching arise.

Given the long history of traditional individual student teaching, implementing team teaching as a field experience model is challenging [5]. Therefore, to assess team teaching performances in teacher education, a follow-up of the student teachers' learning processes is important to guide their professional growth. Furthermore, student teachers could also benefit from a tool to discuss their own collaboration and to indicate joint work points themselves. To that end, measuring student teachers' perceptions of collaborative team teaching experiences is relevant, as these might function as a filter [20] on the collaboration and impact of the team teaching practice. Hence, an easy-to-use valid and reliable questionnaire of student teachers' team teaching perceptions is needed.

2. Collaborative learning through team teaching

Team teaching is a collaborative teaching model that refers to two or more professionals working together in some level of collaboration in the planning, delivery, and evaluation of a course [21, 22]. Co-teaching, collaborative teaching and cooperative teaching are sometimes used synonymously with team teaching.

Team teaching, however, refers to the collaboration between teachers in order to provide quality education to *all* learners, while the other concepts may in some instances be more narrowly defined and refer to the collaboration of a (general) teacher with a special education teacher in order to help learners with specific educational needs [23, 24].

As indicated in the definition, collaboration takes place between two or more professionals. Usually two teachers are involved (i.e., two (general) teachers, or a (general) teacher and a special education teacher), but other ways of collaboration are equally possible (e.g., between three or more professionals, with a student teacher, a mentor during field experiences, a teacher trainer, a child caretaker, a paramedic, or even a larger group of teachers with specific development goals [25]).

In this study, we focus on team teaching as a field experience model applied by student teachers *during teacher education* in which the student teachers have the opportunity to team teach during practical lessons on campus or during internship lessons in schools. Within these contexts, team teaching can be applied by two student teachers, although other formats are equally possible, such as groups of more than two student teachers, a student teacher and a mentor, or a student teacher and a teacher educator. As a consequence, the questionnaire on student teachers' team teaching perceptions must be able to capture these different team teaching contexts.

3. Team teaching models

In the literature several models of team teaching are described. Differences are related to the number of models or sub-models, and the labelling [21, 26]. In this study the typology of Baeten and Simons [21] is used as it is review-based [21]. Their typology distinguishes between five team teaching models based on the level of collaboration between the team teaching partners: (1) the observation model, (2) the coaching model, (3) the assistant teaching model, (4) the equal status model – parallel teaching, sequential teaching and station teaching – and (5) the teaming model [21].

In the observation and coaching models, collaboration is limited as one teacher has full responsibility while the other observes [27, 28] or coaches [29, 30]. A higher level of collaboration becomes evident in the assistant teaching model, where one teacher has the main responsibility, but receives assistance from another teacher who provides support to the learners, uses media, etc. [27, 31]. Several teaching formats are possible in the equal status model: teachers split up the class (parallel teaching) [31], divide the learning contents (sequential teaching) [32, 33], or split up both the class and the learning contents, so that both teachers, with the same status and responsibilities, teach specific content or activities to a subgroup of learners (station teaching) [27, 34]. Finally, in the teaming model, both teachers fully collaborate during the preparation, the delivery and the evaluation of the lessons.

With regard to the application of team teaching models two important observations have to be made. First, it is important that student teachers adopt different roles within a specific model to underline the equivalence of both teaching partners involved, and to optimize the learning effect for both [35]. This recommendation applies in particular to models where one teacher assumes more responsibility, as is the case in the observation, coaching, and assistant teacher models. Second, it is important to vary between models. Several authors point to a growth path in team teaching. More experienced teams often alternate models, even within a single lesson [22, 36].

4. Research aim

Previous empirical studies have emphasized the advantages of team teaching for collaborative learning and encouraged its implementation in teacher education, as it can help offset some of the issues that affect the more traditional model of individual student teaching (for instance lack of support, teaching in isolation), and because it maximizes resources in the classroom [4, 5].

Although the advantages of team teaching for student teachers have been confirmed in multiple studies, disadvantages (for instance conflicting personalities [15, 37], time-intensive planning [38–40]) have been recognized as well. Hence, a review-based overview of the relevant advantages and disadvantages of team teaching for student teachers will be presented in the *Results* section.

Moreover, team teaching practice is related to student teachers' perceptions of team teaching [9]. A number of studies show that teachers' perceptions of collaboration have changed positively due to their experiences with team teaching [41]. Otherwise stated, student teachers' perceptions might function as a filter [20] on the team teaching practice and the accompanying actions. For instance, negative past experiences with collaboration can lead to student teachers being less open to team teaching [42]. Consequently, offering situations where student teachers can have positive team teaching experiences may be a powerful way to foster collaborative learning.

Therefore, to assess team teaching practice in teacher education, stakeholders such as student teachers, teacher educators and mentors are in need of an easy-to-use instrument offering insights into student teachers' perceptions of collaborative team teaching experiences, to guide the learning process and support well-founded decision making.

However, instruments to easily measure perceptions within team taught environments are scarce [9]. Recently, a 16 Likert-items questionnaire for learners has been validated in Belgium and South Africa: the learners' team teaching perceptions questionnaire (LTTPQ) [43]. Contrary to the focus of the current study, the LTTPQ was based on specific characteristics of team taught learning environments *for learners*, such as rich and varied lessons (i.e., variety of teaching styles, multiple perspectives on topics), increased support (i.e., less waiting time for assistance, more differentiation, additional information on learning problems), learning gains (i.e., better understanding, higher quality of school work, higher test scores) and confusion (i.e., different expectations, different responses to questions).

To the best of our knowledge, there is no valid and reliable quantitative instrument available to measure these aspects *for student teachers*. Therefore, the development of such a questionnaire would be a first attempt to quantitatively measure student teachers' team teaching perceptions.

Consequently, the aim of this study is to develop *an easy-to-use valid and reliable quantitative self-report questionnaire to measure student teachers' team teaching perceptions* (main objective), based on *a theoretical framework of student teachers' team teaching advantages and disadvantages* (sub-objective), usable within the context of all team teaching models and within different team teaching formats, regardless of student teachers' team teaching experiences. The student teachers' team teaching perceptions questionnaire (STTPQ) can be implemented as a *growth tool* in order to meet the shifted assessment focus from measuring performances to supporting professional growth [44], allowing teacher education institutes to make well-founded decisions.

5. Methodology

5.1 Research stages

The STTPQ was developed and validated in four stages: an extensive literature review (1) resulting in a preliminary version of the questionnaire containing advantages and disadvantages of team teaching (2). Next, a pilot study was conducted with 14 student teachers in order to improve content validity (3), followed by a further validation and reliability study based on exploratory factor analysis, peer debriefing, confirmatory factor analysis and internal consistency analysis with 181 student teachers (4). Hence, both quantitative and qualitative methods were applied (i.e., mixed methods) in order to increase the reliability of the instrument [45].

5.2 Research contexts and respondents

This study was deliberately conducted in two different teacher education programs in Flanders, Belgium, so that the questionnaire would be sufficiently robust for use in different contexts. The first context consisted of a one-year academic teacher education program which prepares students who have already obtained their master's degree to become secondary school teachers. The second context consisted of a three-year teacher education program, aimed at training students to obtain a bachelor's degree required for primary or lower secondary school teachers.

For the pilot study a small sample of student teachers (N = 14) of the first context, who did not participate in the validation study, were selected on the basis of voluntary participation. The student teachers had already applied team teaching with a peer – student teacher – during field experiences.

The validation and reliability study took place in the second context, including a larger sample of student teachers (N = 181). These student teachers applied different models of team teaching mainly with a peer or exceptionally with a mentor during their field experiences. In accordance with previous research, the student teachers and mentors who acted as team teaching partners were prepared for their new roles (i.e., theoretical knowledge on team teaching) [15] before internship [9]. Student teachers were randomly assigned in pairs to a placement school [18]. Next, a digital version of the STTPQ was administered at two measurement moments (MM): during (MM1; N = 181), and after (MM2; N = 160) the team teaching internship in schools.

5.3 Stage 1: theoretical framework for the STTPQ

An extensive literature review was carried out to create an inventory of all relevant advantages and disadvantages of team teaching for student teachers [21]. Five electronic databases, namely ERIC, FRANCIS, PsychInfo, Scopus and Web of Science were searched with the following terms: *team teaching*, *co-teaching*, *cooperative teaching*, *collaborative teaching* and *paired placement* combined with *teacher education*, *teacher training*, *pre-service teacher*, and *student teacher*.

By reading the abstracts of the retrieved records, relevant manuscripts were identified. In addition, the reference lists of those records were explored to search for other relevant manuscripts. The following inclusion criteria were applied: (1) The literature search started in the year 2000; (2) In order to ensure the quality of the review study, manuscripts had to be peer reviewed.

The literature review resulted in a corpus of 33 peer-reviewed manuscripts, which were read thoroughly to identify advantages and disadvantages of team teaching, and coded into themes in NVivo software. The coding process was data-driven, based on a review of the literature. The themes were further explored in the manuscripts and incorporated into a narrative review providing qualitative descriptions of student teachers' team teaching advantages and disadvantages [46].

5.4 Stage 2: preliminary STTPQ

The preliminary STTPQ was developed based on the results of the literature review. The following criteria were used for the development of the items. First, the items had to represent the advantages and disadvantages retrieved from the reviewed literature. Second, the items had to be clearly formulated (as in not interpretative). Third, the items had to be unique (as in distinctive). Last, the items had to be universal (as in understandable in different contexts). Additionally, the use of the scaling technique was applied as it offers significant benefits over the use of a single question: it increases both the validity and reliability of the scale [47, 48]. The answering statements consist of a 5-point Likert scale ranging from *I totally disagree* to *I totally agree*.

5.5 Stage 3: pilot study

A pilot study with 14 student teachers was conducted to increase the content validity of the preliminary STTPQ. Accordingly, all items were tested through cognitive interviews – a suitable technique to reveal the reasoning of respondents when answering the questions [49, 50] – by using the think-aloud method [51]. All 14 student

teachers were interviewed independently by two researchers to reduce the possibility of missing out on important information. On the basis of the 14 cognitive interviews, several adjustments were made at item level, allowing all items to be retained.

5.6 Stage 4: validity and reliability of the STTPQ

The validation and the reliability study of the STTPQ was conducted by means of a combination of exploratory factor analysis (EFA), peer debriefing, confirmatory factor analysis (CFA), and internal consistency analysis. Evidence to use the data for factor analysis was verified by the Kaiser-Meyer-Olkin test (> 0,80 = adequate) [52] and the Bartlett's test of sphericity. The Lavaan package (version 0,6–7) [53] and the Psych package (version 2.0.12) [54] in Rstudio (http://www.rstudio.com/) were used to perform the statistical analyses.

First, an EFA was conducted in order to estimate the underlying factor structure of the data, i.e., without using a pre-defined hypothesized factor structure. To this end, data of the student teachers' first measurement moment (MM1) were analyzed, using the maximum likelihood method with orthogonal rotation, in which factors – latent variables – and items – manifest variables – were retained and distinguished. Three criteria were used to determine the number of factors: (1) the Kaiser criterion (eigenvalues >1) [55], (2) the Cattell criterion (factors before the inflection point) [56] and (3) the content criterion (theoretically comprehensible). Additionally, items that loaded high (> 0,40) on one factor were included. By contrast, items that loaded high on one factor (> 0,40) and also fairly high (< 0,40) on another factor, with a difference of 0,15 or less between loadings, were excluded. Next, an item-total test correlation was used to recheck item validity measures in which each item should correlate – with a minimum of 0.20 as the cutoff value – with the total scale test score [57].

Furthermore, the reliability of the retained factor structure was verified in order to exclude items that did not meet the requirements for internal consistency. In the interpretation of the internal consistency, the following Cronbach's alpha values were used: $\alpha < 0{,}60$ = bad; $0{,}60 \leq \alpha < 0{,}80$ = reasonable; $\alpha \geq 0{,}80$ = good [58].

Since a factor structure was retained without using a pre-defined hypothesized factor structure (i.e., EFA), a further theoretical fine-tuning during a peer debriefing session with four researchers was necessary to maintain content validity (i.e., sufficiently representative) and construct validity (i.e., meaningful scales). Therefore, all factors and related items were checked for internal consistency, content, scales and factors.

Subsequently, a CFA was conducted on the same data (MM1) to verify whether the data fitted the pre-defined hypothesized factor structure with the remaining items and scales. To evaluate the fit, various indices were studied: (1) the Comparative Fit Index (CFI), (2) the Tucker-Lewis Index (TLI) and (3) the Root-Mean-Square-Error-of-Approximation (RMSEA). For the CFI and the TLI, a value equal to or greater than 0,90 is a good fit [59]. Concerning the RMSEA, a cut-off value close to 0,06 is considered good [60].

Next, stepwise improvements, based on the modification indices, were added. Improvements were only made if the Akaike Information criterion (AIC) of the new model was significantly lower than before (cf. Pr(>Chisq) < 0,05).

Subsequently, a repeated EFA and CFA were conducted with similar data of the student teachers' second measurement moment (MM2) in order to find evidence for the pre-defined hypothesized factor structure over time. Next, an item-total test correlation was used to recheck item validity measures at MM1 and MM2. Finally, the internal consistency for both measurement moments was analyzed in order to verify the reliability of the validated items in scales.

6. Results

The results of the four different development and validation stages of the STTPQ questionnaire will be chronologically and separately presented: (1) theoretical framework of student teachers' team teaching advantages and disadvantages, (2) preliminary version of the STTPQ, (3) results of the pilot study, and (4) results of the validation and reliability study of the questionnaire.

6.1 Theoretical framework for the STTPQ: student teachers' team teaching advantages and disadvantages

Table 1 offers an overview of the advantages and disadvantages team teaching can have for student teachers, including the main references for each advantage and disadvantage that was retrieved from the literature.

The literature showed that team teaching offers several advantages to student teachers. These advantages are fourfold: (1) increased support, (2) increased dialog about learning and teaching, (3) professional growth, and (4) personal growth.

Team teaching provides *increased support* to student teachers [17, 23, 61–64]. During team teaching they experience both emotional and professional support from their peer. This can be explained by the fact that the team teaching partner is a peer and therefore at the same level, which makes it easier to share experiences and to complement each other's strengths and weaknesses. Next, team teaching provides additional opportunities to *dialog* about learning and teaching [38, 61, 65]. Student teachers ask each other's opinion, analyze their approach and discuss alternatives more frequently. Besides, team teaching stimulates *professional growth* in the domains of teaching, collaboration, and reflection [37, 41, 66, 67]. Student teachers' didactical, pedagogical and classroom management skills increase; they learn how to give each other feedback, how to plan and they reflect better on what works and what does not. Through the presence of a peer in the classroom, student teachers also experience *personal growth* [23, 68, 69]. Their sense of self-confidence and self-efficacy increases. This growth can be explained by the fact that they feel as if they are not the only one who is afraid or experiencing difficulties.

Advantages	**Main references**
Increased support	Bronson and Dentith (2014); Bullough et al. (2002); Carless (2016); Dee (2012); Gardiner and Robinson (2010); Kamens (2007)
Increased dialog	Birrell and Bullough (2005); Gardiner and Robinson (2009); Nokes et al. (2008)
Professional growth	Bashan and Holsblat (2012); Nguyen and Baldauf (2010); Shin et al. (2007); Stairs et al. (2009)
Personal growth	Chanmugan and Gerlach (2013); Gardiner (2010); Kamens (2007)
Disadvantages	**Main references**
Lack of compatibility	Bashan and Holsblat (2012); Stairs et al. (2009); Tobin et al. (2001)
Comparison between peers	Goodnough et al. (2009); Stairs et al. (2009)
Difficulty of providing constructive feedback	Parson and Stephenson (2005); Sorensen (2004)
Increased workload	Gardiner and Robinson (2011); Nokes et al. (2008); Vacilotto and Cummings (2007)

Table 1.
Advantages and disadvantages of team teaching for student teachers retrieved from the literature.

Despite these advantages, four disadvantages of team teaching for student teachers are recognized as well: (1) lack of compatibility of peers, (2) comparison between peers (3) difficulty of providing constructive feedback and (4) increased workload.

A *lack of compatibility* between peers can harm the effectiveness of team teaching [37, 67, 70]. Potential problems, such as conflicting personalities, differences in opinions, differences in conceptions of teaching, a weaker peer relying too much on his partner, or an unfair workload division may hinder collaboration. *Comparison between peers* [67, 71] might occur when student teachers fear that one would outperform the other or when the mentor has a favorite student teacher who receives more attention. Some studies indicated that student teachers experience *difficulties in providing constructive feedback* [15, 72]. If student teachers do not know their peer well and if they do not have the time to build up mutual respect and trust, they are afraid to offend their peer and often only give positive and superficial feedback. Finally, some researchers reported an *increased workload* as a disadvantage [38–40] since finding time to plan lessons and reflect with the peer is challenging, but essential for team teaching.

6.2 Preliminary STTPQ

The preliminary version of the STTPQ includes 47 Likert-items organized in five scales to measure student teachers' team teaching perceptions. These five scales are based on the advantages and disadvantages of team teaching described in the theoretical framework: (1) *support* (14 items), (2) *dialog* (5 items), (3) *growth* (14 items), (4) *complexity* (6 items), and (5) *workload* (8 items). The *growth* scale includes the initial subscales *professional growth* and *personal growth*. The *complexity* scale includes three initial subscales, namely *lack of compatibility*, *comparison between peers* and *difficulty of providing constructive feedback*.

Table 2 shows the 47 items of the preliminary questionnaire with the corresponding scales. Each scale consists of at least five items, which allows removal of problematic items during the validation and reliability study.

6.3 Pilot study

The pilot study resulted in adjustments at item level. Seven items were reformulated. First, Item 6 *I found reflecting on our lessons together insightful* was reformulated in *By reflecting on the lessons with my team teaching partner, I gained more insight in my own qualities as a teacher*. Second, Item 7 *By preparing our lessons together, we dared to experiment* was reformulated in *By preparing our lessons together, we dared to experiment with new activities and approaches*. Third, Item 9 *I was tense because of the presence of my team teaching partner* was reformulated in *The presence of my team teaching partner during my lessons gave me extra stress*. Fourth, Item 16 *The presence of my team teaching partner made me feel more confident in front of the class* was reformulated in *I felt more confident thanks to the presence of my team teaching partner during the lessons*. Fifth, Item 35 *I could share my teaching experiences with my team teaching partner* was reformulated in *I discussed my teaching experiences with my team teaching partner*. Sixth, Item 37 *I have grown on a personal level (e.g., self-confidence, social skills)* was reformulated in *The team taught lessons were beneficial to my self-confidence*. Finally, Item 40 *By comparing myself with my team teaching partner I discovered my own points of improvement* was reformulated in *Teaching with my team teaching partner made me reflect on my own strengths and weaknesses as a teacher.* All seven reformulated items as well as the 40 unmodified items were used for the validation and the reliability study of the questionnaire.

No.	Item	Scale
1	I could rely on my team teaching partner for questions and concerns.	Support
2	My team teaching partner gave me professional support (e.g. ideas, useful information).	Support
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.	Support
6	I found reflecting on our lessons together insightful.	Growth
7	By preparing our lessons together, we dared to experiment.	Growth
8	I had enough possibilities to share my teaching experiences with my team teaching partner.	Dialog
9	I was tense because of the presence of my team teaching partner.	Support
10	The differences between my team teaching partner and I complicated our collaboration.	Complexity
11	The team teaching activities required hard work.	Workload
12	I learnt a lot by preparing the lessons with my team teaching partner.	Growth
13	My team teaching partner and I complemented each other very well.	Support
14	The collaboration with my team teaching partner was efficient.	Support
15	I felt more motivated during the team teaching activities.	Growth
16	The presence of my team teaching partner made me feel more confident in front of the class.	Growth
17	During the team teaching activities I had to memorize many things at once.	Workload
18	I had enough possibilities to exchange ideas with my team teaching partner.	Dialog
19	Without the presence of a team teaching partner, I feel more comfortable.	Support
20	During the team taught lessons I learnt things I would not have learnt during individual lessons.	Growth
21	I have learnt to give (better) constructive feedback to my team teaching partner.	Growth
22	During the team teaching activities I had to make difficult decisions.	Workload
23	The workload for a team taught lesson was high.	Workload
24	I regularly exchanged information with my team teaching partner.	Dialog
25	I got along very well with my team teaching partner.	Support
26	My team teaching partner was a source of information.	Support
27	It took a lot of time to prepare the lessons together.	Workload
28	I prefer to prepare my lessons alone instead of doing this together.	Workload
29	Thanks to the collaboration with my team teaching partner, I reflected better on what does and what does not work.	Growth
30	The collaboration with my team teaching partner made me more aware of the importance of good fellowship.	Growth
31	The competition between my team teaching partner and I complicated our collaboration.	Complexity
32	My team teaching partner gave me emotional support (e.g. encouragements, a listening ear).	Support
33	The presence of my team teaching partner made me feel more at ease.	Support

No.	Item	Scale
34	By preparing our lessons together, we dared to try out new things.	Growth
35	I could share my teaching experiences with my team teaching partner.	Dialog
36	I have had more work than if I would have given exclusively individual lessons.	Workload
37	I have grown on a personal level (e.g., self-confidence, social skills).	Growth
38	I discussed my ideas and experiences with my team teaching partner.	Dialog
39	I felt more secure by preparing the lessons together.	Support
40	By comparing myself with my team teaching partner I discovered my own points of improvement.	Growth
41	The team taught lessons required a high level of concentration and accuracy.	Workload
42	I would have felt less anxious if I only had to give individual lessons.	Support
43	My team teaching partner gave me useful feedback on my lessons.	Support
44	I had difficulties giving my opinion to my team teaching partner.	Complexity
45	The comparison between my team teaching partner and I (e.g. by pupils, by the mentor) bothered me.	Complexity
46	During the team teaching activities, I felt competent to teach.	Growth
47	The team teaching activities convinced me even more of the fact that I want to become a teacher.	Growth

Table 2.
Preliminary STTPQ including 47 Likert-items.

6.4 Validation and reliability of the STTPQ

Before conducting the analyses, all data were checked for missing data: 23,2% of the data were missing for MM1 and 12,5% for MM2. All missing data were excluded: the missing data of MM1 were extracted from the dataset of MM1 and analog for MM2. Moreover, evidence to use the data for factor analysis was confirmed by the Kaiser-Meyer-Olkin test (MM1 = 0,89; MM2 = 0,88) and the Bartlett's test of sphericity (MM1: $\chi 2 = 4113{,}19$, $df = 1081$, $p < 0{,}001$; MM2: $\chi 2 = 4464{,}63$, $df = 1081$, $p < 0{,}001$).

6.4.1 Exploratory factor analysis

The EFA revealed that a 4-factor structure is statistically valid for the questionnaire (**Table 3**). First, the scree plot showed four factors before the inflection point. Second, three factors had eigenvalues above 1 and one factor had an eigenvalue very close to 1 (i.e., 0,999). Third, the factors were theoretically comprehensible in terms of content. The four factors together explained 47% of the total variance.

At item level, there was a downgrade from 47 items to 34 items: eight items loaded insufficiently (< 0,40) and five items loaded highly on more than one factor. Although Item 45 had a factor load value of 0,38 just below the limit of 0,40, the item was retained as it correlated well with the overall scale (0,48). Additionally, there was a further downgrade to 33 items as shown in **Table 3**. Item 27 was excluded to improve the internal consistency of the third factor ($\alpha = 0{,}66 -> \alpha = 0{,}71$).

Consequently, the first factor includes 17 items ($\alpha = 0{,}95$) of the scales *support*, *growth*, *complexity* and *dialog*: 1, 2, 6, 8, 10, 12, 13, 14, 24, 25, 26, 29, 32, 34, 40, 43 and 46. The second factor comprises 8 items ($\alpha = 0{,}88$) of the scales *support* and *growth*: 5, 9, 15, 16, 19, 33, 39 and 42. The third factor covers four items ($\alpha = 0{,}71$) of the scale *workload*: 11, 17, 22 and 23, whereas the fourth factor includes four items

	Rotated factor load values					
Item no	**Factor 1**	**Factor 2**	**Factor 3**	**Factor 4**	**Corrected item-total correlation**	**Cronbach's alpha if the item is deleted**
1	0,81				0,81	0,94
2	0,81				0,79	0,94
6	0,61				0,67	0,94
8	0,62				0,69	0,94
10	−0,66				0,73	0,94
12	0,52				0,64	0,94
13	0,75				0,83	0,94
14	0,75				0,78	0,94
24	0,58				0,70	0,94
25	0,76				0,79	0,94
26	0,86				0,79	0,94
29	0,45				0,54	0,95
32	0,66				0,73	0,94
34	0,51				0,62	0,94
40	0,46				0,46	0,95
43	0,77				0,76	0,94
46	0,41				0,45	0,95
5		0,83			0,78	0,85
9		−0,51			0,59	0,87
15		0,51			0,48	0,88
16		0,79			0,73	0,85
19		−0,59			0,69	0,86
33		0,77			0,80	0,85
39		0,53			0,58	0,87
42		−0,49			0,50	0,88
11			0,59		0,52	0,58
17			0,51		0,47	0,60
22			0,45		0,41	0,63
23			0,56		0,53	0,57
27			0,43		0,23	0,71
3				0,44	0,46	0,58
4				0,47	0,48	0,56
44				0,42	0,34	0,66
45				0,38	0,48	0,56
Cumulative variance	0,23	0,30	0,42	0,47		
Cronbach's alpha	0,95	0,88	0,67	0,66		

Table 3.
Results of the exploratory factor analysis and reliability analysis.

(α = 0,66) of the scale *complexity*: 3, 4, 44 and 45. All remaining items correlated well (> 0,20) with the total scale test score.

6.4.2 Peer debriefing

The retained 4-factor structure was subjected to a theoretical fine-tuning during a peer debriefing session, based on the literature of collaborative learning and the theoretical framework for the questionnaire. Factor 1 included 17 items of the theoretical assumed scales support, growth, complexity and dialog. This large scale comprised 6 items in which specifically the aspect of support by means of positive feelings of *collaboration* and social cohesion are central [73], whereas the remaining 11 items pointed to the aspect of deliberate and active co-creation [11]. Additionally, Factor 3 and Factor 4 could be theoretically merged as they both are disadvantages of team teaching [21].

Finally, as shown in **Table 4** the renewed four factors were labeled based on the content of the items and their underlying construct: (1) the *collaboration* scale included 6 items (α = 0,92): 1, 10, 13, 14, 25 and 32, (2) the *co-creation* scale 11 items (α = 0,90): 2, 6, 8, 12, 24, 26, 29, 34, 40, 43 and 46, (3) the *coaching* scale 8 items (α = 0,88): 5, 9, 15, 16, 19, 33, 39 and 42, and (4) the *complexity* scale also 8 items (α = 0,70): 3, 4, 11, 17, 22, 23, 44 and 45. In sum, the 4-factor structure was kept by moving some items to another factor, still resulting in 33 reliable remaining items.

6.4.3 Confirmatory factor analysis

In order to check if the data of the first measurement moment (MM1) fitted the pre-defined 4C-factor structure – *collaboration*, *co-creation*, *coaching* and *complexity* – with 33 items, a CFA was conducted. The results showed that the model did not entirely fit the data: CFI = 0,856, TLI = 0,844 and RMSEA = 0.073. Based on the modification indices, five error-covariances (~~) between items were included and three not unifactorial items were excluded in chronological order: (1) excluding item 44, (2) Item 3 ~ ~ Item 4, (3) Item 15 ~ ~ Item16, (4) Item 5 ~ ~ Item 16, (5) Item 6 ~ ~ Item 29, (6) excluding Item 10, (7) Item 46 ~ ~ Item 11) and (8) excluding Item 9. Finally, Model 9 with 30 remaining items had an adequate fit: CFI = 0,919, TLI = 0,911 and RMSEA = 0,057 (**Table 5**). In terms of reliability, all scales showed reasonable to good overall internal consistency: *collaboration* (α = 0,90), *co-creation* (α = 0,90), *coaching* (α =0,87) and *complexity* (α = 0,69).

6.4.4 Repeated exploratory and confirmatory factor analysis

As part of a rigorous validity check over time, a repeated EFA and CFA were conducted [74], albeit with data from the second measurement moment (MM2). The EFA of MM2 confirmed the 4-factor structure of MM1: the scree plot showed

Scale	No of items	Items	Cronbach's alpha
Collaboration	6	1, 10, 13, 14, 25, 32	0,92
Co-creation	11	2, 6, 8, 12, 24, 26, 29, 34, 40, 43, 46	0,90
Coaching	8	5, 9, 15, 16, 19, 33, 39, 42	0,88
Complexity	8	3, 4, 11, 17, 22, 23, 44, 45	0,70

Table 4.
Results of the theoretical fine-tuning.

Model	CFI	TLI	RMSEA	AIC	Pr(>Chisq)	Action
Model 1	0,856	0,844	0,073	10766		Excluding Item 44
Model 2	0,874	0,864	0,069	10336	Fit 1 - Fit2: $p < 0,01$	Item 3 ~ ~ Item 4
Model 3	0,883	0,873	0,067	10315	Fit 2 - Fit3: $p < 0,01$	Item 15 ~ ~ Item 16
Model 4	0,891	0,881	0,065	10297	Fit 3 - Fit4: $p < 0,01$	Item 5 ~ ~ Item 16
Model 5	0,899	0,890	0,062	10278	Fit 4 - Fit5: $p < 0,01$	Item 6 ~ ~ Item 29
Model 6	0,905	0,896	0,060	10265	Fit 5 - Fit6: $p < 0,01$	Excluding Item 10
Model 7	0,905	0,896	0,061	9964	Fit 6 - Fit7: $p = 0,04$	Item 46 ~ ~ Item 11
Model 8	0,911	0,902	0,059	9952	Fit 7 - Fit8: $p < 0,01$	Excluding Item 9
Model 9	0,919	0,911	0,057	9631	Fit 8 - Fit9: p < 0,01	

Table 5.
Results of the modifications to Model 1: fit indices.

four factors before the inflection point and four factors had eigenvalues above 1, which explained 49% of the total variance. Next, the CFA revealed that the 4C-factor structure – *collaboration*, *co-creation*, *coaching* and *complexity* – of Model 9 with 30 items and five co-variances did not entirely fit the data: CFI = 0,814, TLI = 0,795 and RMSEA = 0,090. Therefore, Model 9 was further improved (**Table 6**). Based on the modification indices, eight error-covariances (~~) between items were included and one non-unifactorial item was excluded in chronological order: (1) Item 1 ~ ~ Item 2, (2) Item 12 ~ ~ Item 39, (3) Item 32 ~ ~ Item33, (4) excluding Item 40, (5) Item 6 ~ ~ Item 43, (6) Item 2 ~ ~ Item 26, (7) Item 2 ~ ~ Item 34, (8) Item 3 ~ ~ Item 45 and (9) Item 4 ~ ~ Item 45. Finally, the retained Model 18 with 29 remaining items had an adequate fit for MM2 (CFI = 0,915, TLI = 0,904 and RMSEA = 0,063) as well as for MM1 (CFI = 0,947, TLI = 0,939 and RMSEA = 0,048).

Moreover, evidence of item validity was attained as all items for both MM1 and MM2 correlated well (> 0,20) with the total scale test score (**Table 7**). **Table 7** also indicates that the reliability of all four scales of Model 18 showed reasonable to good overall internal consistency for MM1: *collaboration* (α = 0,90), *co-creation* (α = 0,90), *coaching* (α =0,87), and *complexity* (α = 0,69). These scales also remained

Model	CFI	TLI	RMSEA	AIC	Pr(>Chisq)	Action
Model 9	0,814	0,795	0,090	10522		Item 1 ~ ~ Item 2
Model 10	0,844	0,827	0,083	10451	Fit 1 - Fit2: $p < 0,01$	Item 12 ~ ~ Item 39
Model 11	0,858	0,843	0,079	10418	Fit 2 - Fit3: $p < 0,01$	Item 32 ~ ~ Item 33
Model 12	0,869	0,854	0,076	10393	Fit 3 - Fit4: $p < 0,01$	Excluding Item 40
Model 13	0,882	0,868	0,074	10003	Fit 4 - Fit5: $p < 0,01$	Item 6 ~ ~ Item 43
Model 14	0,888	0,875	0,072	9989	Fit 5 - Fit6: $p < 0,01$	Item 2 ~ ~ Item 26
Model 15	0,895	0,882	0,070	9974	Fit 6 - Fit7: $p = 0,01$	Item 2 ~ ~ Item 34
Model 16	0,901	0,888	0,068	9961	Fit 7 - Fit8: $p < 0,01$	Item 3 ~ ~ Item 45
Model 17	0,906	0,894	0,066	9949	Fit 8 - Fit9: p < 0,01	Item 4 ~ ~ Item 45
Model 18	0,915	0,904	0,063	9928	Fit 9 - Fit10: p < 0,01	

Table 6.
Results of the modifications to Model 9: fit indices.

Item no					
Collaboration	**Co-creation**	**Coaching**	**Complexity**	**Corrected item-total correlation of MM1**	**Corrected item-total correlation of MM2**
1				0,79	0,74
13				0,78	0,82
14				0,79	0,81
25				0,80	0,82
32				0,68	0,78
	2			0,77	0,66
	6			0,65	0,62
	8			0,67	0,71
	12			0,64	0,58
	24			0,70	0,71
	26			0,74	0,76
	29			0,56	0,59
	34			0,62	0,59
	43			0,71	0,72
	46			0,45	0,26
		5		0,77	0,77
		15		0,52	0,61
		16		0,75	0,78
		19		0,65	0,69
		33		0,80	0,75
		39		0,58	0,51
		42		0,47	0,61
			3	0,39	0,52
			4	0,39	0,43
			11	0,41	0,27
			17	0,39	0,40
			22	0,37	0,29
			23	0,50	0,42
			45	0,40	0,44
MM1 α = 0,90 MM2 α = 0,92	MM1 α = 0,90 MM2 α = 0,89	MM1 α = 0,87 MM2 α = 0,88		MM1 α = 0,69 MM2 α = 0,68	

Table 7.
Results of the validity and reliability analyses for MM1 and MM2.

reliable for MM2: *collaboration* (α = 0,92), *co-creation* (α = 0,89), *coaching* (α =0,88), and *complexity* (α = 0,68). As a result, the final questionnaire comprises 29 Likert-items in four scales and appears to be both valid and reliable over time: (1)

No.	New no.	Item	Scale
1	1	I could rely on my team teaching partner for questions and concerns.	Collaboration
2	2	My team teaching partner gave me professional support (e.g. ideas, useful information).	Co-creation
3	3	I felt as if there was competition between my team teaching partner and I.	Complexity
4	4	I was concerned that my team teaching partner would teach better than me.	Complexity
5	5	Teaching the lessons alongside my team teaching partner made me feel at ease.	Coaching
6	6	By reflecting on the lessons with my team teaching partner, I gained more insight in my own qualities as a teacher.	Co-creation
8	7	I had enough possibilities to share my teaching experiences with my team teaching partner.	Co-creation
11	8	The team teaching activities required hard work.	Complexity
12	9	I learnt a lot by preparing the lessons with my team teaching partner.	Co-creation
13	10	My team teaching partner and I complemented each other very well.	Collaboration
14	11	The collaboration with my team teaching partner was efficient.	Collaboration
15	12	I felt more motivated during the team teaching activities.	Coaching
16	13	I felt more confident thanks to the presence of my team teaching partner during the lessons.	Coaching
17	14	During the team teaching activities I had to memorize many things at once.	Complexity
19	15	Without the presence of a team teaching partner, I feel more comfortable.	Coaching
22	16	During the team teaching activities I had to make difficult decisions.	Complexity
23	17	The workload for a team taught lesson was high.	Complexity
24	18	I regularly exchanged information with my team teaching partner.	Co-creation
25	19	I got along very well with my team teaching partner.	Collaboration
26	20	My team teaching partner was a source of information.	Co-creation
29	21	Thanks to the collaboration with my team teaching partner, I reflected better on what does and what does not work.	Co-creation
32	22	My team teaching partner gave me emotional support (e.g. encouragements, a listening ear).	Collaboration
33	23	The presence of my team teaching partner made me feel more at ease.	Coaching
34	24	By preparing our lessons together, we dared to try out new things.	Co-creation
39	25	I felt more secure by preparing the lessons together.	Coaching
42	26	I would have felt less anxious if I only had to give individual lessons.	Coaching
43	27	My team teaching partner gave me useful feedback on my lessons.	Co-creation
45	28	The comparison between my team teaching partner and I (e.g. by pupils, by the mentor) bothered me.	Complexity
46	29	During the team teaching activities I felt competent to teach.	Co-creation

Table 8.
A valid and reliable 4C-STTPQ with 29 Likert-items.

collaboration (1, 13, 14, 25 and 32), (2) *co-creation* (2,6, 8, 12, 24, 26, 29, 34, 43 and 46), (3) *coaching* (5, 15, 16, 19, 33, 39 and 42), and *complexity* (3, 4, 11, 17, 22, 23 and 45).

6.5 Valid and reliable 4C-student teachers' team teaching perceptions questionnaire

The valid and reliable 4C-questionnaire is a self-report instrument that includes 29 Likert-items organized in four scales: *collaboration* (5 items), *co-creation* (10 items), *coaching* (7 items), and *complexity* (7 items), in order to measure student teachers' team teaching perceptions (**Table 8**).

7. Conclusion and discussion

Team teaching may be a powerful way to foster collaborative learning between student teachers. To support the implementation of team teaching and to assess team teaching practices in teacher education, stakeholders such as student teachers, teacher educators and mentors are in need of an instrument that offers insights into student teachers' perceptions of collaborative team teaching experiences, in order to guide the learning process and support well-founded decision making.

Therefore, the aim of this study was to develop *an easy-to-use valid and reliable quantitative self-report questionnaire to measure student teachers' team teaching perceptions*, the STTPQ, based on *a theoretical framework of student teachers' team teaching advantages and disadvantages*, usable within the context of all team teaching models and within different team teaching formats, regardless of student teachers' team teaching experiences.

Both quantitative and qualitative methods were applied in the development and validation of the STTPQ in four stages. During the first stage, a theoretical framework was developed through an extensive literature review of student teachers' team teaching advantages and disadvantages. The results showed that the advantages are fourfold: (1) emotional and professional support, (2) increased dialog about learning and teaching, (3) professional growth and (4) personal growth. Despite these advantages, four disadvantages are recognized as well: (1) lack of compatibility of peers, (2) comparison between peers, (3) difficulty of providing constructive feedback, and (4) increased workload.

In the final stage, the validation and the reliability study of the questionnaire were conducted by means of a combination of exploratory factor analysis, peer debriefing, confirmatory factor analysis, and internal consistency analysis. Factor analysis proved that the original five scales based on our literature study on the advantages and disadvantages of team teaching: (1) support, (2) dialog, (3) growth, (4) complexity and (5) workload could not be retained. Instead, a 4-factor structure with scales (1) *collaboration*, (2) *co-creation*, (3) *coaching* and (4) *complexity*, resembled best how the student teachers experienced team teaching. Two of these scales strongly related to general positive or negative feelings related to team teaching: positive or negative feelings of social cohesion based on collaboration or positive or negative feelings related to complexity and workload. Interestingly, these two dimensions resemble the model on team learning as elaborated by Van den Bossche, Gijselaers, Segers and Kirschner (2006) with on the one hand a focus on collaborative learning as promoting understanding through *mutually shared cognition*, on the other hand the importance of group members beliefs about the interpersonal context. As the authors state: "The above-presented constructs fit into a model of collaborative work in which beliefs about the interpersonal context

shape the willingness to engage in learning behavior. Learning behavior is defined as processes of construction and co-construction of meaning, with constructive conflict as a vehicle to enhance (co-)construction. This learning behavior gives rise to mutually shared cognition, leading to higher team effectiveness." (p. 502) [11]. Therefore, the research strand of team learning seems a promising approach to investigate the effect and underlying success factors of team teaching.

In sum, the final questionnaire comprises 29 Likert-items in four scales – *collaboration*, *co-creation*, *coaching* and *complexity* –and appears to be valid and reliable over time. Evidence of item validity was attained as all items for both measurement moments correlated well (> 0,20) with the total scale test score. Furthermore, the reliability of all four scales showed similar results for both measurement moments. The overall internal consistency was reasonable to good for MM1: *collaboration* (α = 0,90), *co-creation* (α = 0,90), *coaching* (α =0,87), and *complexity* (α = 0,69), as well as for MM2: *collaboration* (α = 0,92), *co-creation* (α = 0,89), *coaching* (α =0,88), and *complexity* (α = 0,68).

Notwithstanding this result, there are some limitations. First, the five hypothesized scales based on the literature review did not match the 4-factor structure of the first and repeated exploratory factor analyses. In addition, a number of interesting items and underlying scales that did not meet the requirements for validity and reliability had to be excluded.

Subsequently, in order to measure student teachers' team teaching perceptions regardless of their team teaching experience, it is important to use the questionnaire not only for student teachers with limited team teaching experience (as is the case in this study), but also for student teachers with more extensive team teaching experience. In order to further verify the validity and reliability of the STTPQ, the questionnaire should be administered in these contexts of teacher education as well.

The focus of this research was specifically on perceptions of team teaching by student teachers. An interesting avenue for further research could be to pilot this questionnaire in different types of educational settings, where team teaching is applied by in-service teachers and/or other educational professionals. Therefore, future research is encouraged to apply and validate the STTPQ in other educational settings.

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