Teaching and Teacher Education 86 (2019) 102890

Contents lists available at ScienceDirect

Teaching and Teacher Education

journal homepage: www.elsevier.com/locate/tate

Using uncertainty as a learning opportunity during pre-lesson conferences in the teaching practicum

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HIGHLIGHTS

- Student teachers' uncertainties in lesson planning can be identified with linguistic cues.
- Pre-lesson conferences can prepare student teachers for the uncertainty of actual practice.
- Student teachers' uncertainty mainly pertained to instructional design and content.
- Student teachers with higher pedagogical content knowledge discussed their uncertainties more openly.
- Cooperating teachers can take on different roles to support inquiry and knowledge development.

ARTICLE INFO

Article history:
Received 21 December 2018
Received in revised form
17 June 2019
Accepted 31 July 2019
Available online 21 August 2019

ABSTRACT

This qualitative study examined transcripts and video-data from 32 pre-lesson conferences of 14 cooperating teacher-student teacher dyads during the teaching practicum. It used a linguistic approach to capture student teacher uncertainty, while also considering their teaching experience and pedagogical content knowledge. Cooperating teachers' responses to uncertainty were explored in relation to student teachers' instructional quality (as perceived by the student teachers and their pupils). This study illustrates the potential of using uncertainty as a learning opportunity and suggests new possibilities for how cooperating teachers could constructively respond to uncertainty in mentoring conversations..

Teaching practicums constitute an important part of teacher education (Flores, 2016) and are highly valued by student teachers (Hascher, Cocard, & Moser, 2004). During a teaching practicum, a student teacher is given the opportunity to try the "art of teaching", and as a result, a teaching practicum usually creates a mixture of anticipation, anxiety, excitement, and apprehension (Poulou, 2007). To support student teachers effectively, Le Maistre and Paré (2010) suggested that instead of only providing clear-cut solutions to problems, teacher educators should provide student teachers with realistic and ill-defined problems which model the uncertainty of actual practice.

Managing uncertainty and developing a positive attitude towards it is important because uncertainty is an enduring component of teaching and forms a part of teachers' daily work in classrooms (Floden & Clark, 1988). Uncertainty can be troubling for student teachers when they enter the teaching phase of their teacher education programs. Here they are confronted with a lot of important decisions, such as choosing between several instructional designs, deciding on the content of a lesson that needs to be appropriate to pupils' knowledge and abilities, and trying to implement their plans while keeping control of the classroom.

Collaboration is often cited as a strategy to positively influence student teachers' acceptance and management of uncertainty (e.g., Capobianco, 2011). Collaboration with a cooperating teacher,[1] who challenges student teachers' thinking, and encourages reflective experimentation with new practices and ideas, can help to build a shared sense of purpose and tolerance towards the uncertainty of the profession (Helsing, 2007). Schuck and Buchanan (2012), and Loughran (2005) emphasized the need for teacher educators and cooperating teachers to prepare and encourage student teachers to accept and embrace uncertainty. But conceding uncertainty may be

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[1] The literature on teaching practicums presents great variation in terminology to refer to people responsible for the support of prospective teachers (see Hoffman et al., 2015). To avoid any ambiguity, in this study, the term "cooperating teacher" is used to denote a classroom teacher with an additional responsibility as a mentor of prospective teachers, called "student teachers".

https://doi.org/10.1016/j.tate.2019.102890

uncomfortable for cooperating teachers, as their acting role as somebody who "has to know" might pressure them to provide perfect solutions (Schuck & Buchanan, 2012). Therefore, while collaboration with a cooperating teacher during the teaching practicum may offer the context for student teachers to familiarize themselves with the uncertainty of teaching, it is unclear how teacher-related uncertainties are dealt with in lesson conferences between cooperating teachers and student teachers and how these uncertainties can be transformed into useful learning opportunities.

Our framework follows Dewey's idea of reflective thinking, which usually starts with a situation characterized by uncertainty and hesitation (1933, p. 12), and we conceptualize uncertainty as an unsolved design problem emerging from either a lack of knowing or a doubt when considering a range of alternatives. Thus, the study aims to understand what uncertainties arise during lesson planning in pre-lesson conferences, as well as how student teachers express them, and which cooperating teacher responses to these uncertainties may foster student teachers' instructional learning. We hope that this study will help to raise awareness of the importance of researching and addressing student teacher uncertainties during teaching practicums.

1. Uncertainty in teaching

The concept of uncertainty in the context of teaching is complex and has been explored first by Jackson (1990), Lortie (1975), and Floden and Clark (1988). They differentiated between various aspects of teaching that can create uncertainty: lesson related factors, the task structure, and the nature of school organizations. Regarding lesson planning, Floden and Clark (1988) proposed five sources of teaching uncertainty: 1) teachers' influence on pupils' learning, which involves teachers questioning what pupils already know and how their understanding changes over time (pupils' knowledge), 2) uncertainties about the impact of classroom practices on pupil learning (instructional design), 3) questions related to the selection of content (instructional content), 4) uncertainties regarding social and intellectual authority (teacher authority), and 5) the teachers' capacity to improve practice (practice improvement). According to Floden and Clark, some of these uncertainties are more salient than others and they recommend that teacher educators should try to raise awareness of those uncertainties that are less likely to surface during everyday classroom experience.

2. Dealing with uncertainty

As one might expect, some student teachers regard uncertainty as a threat and tend to avoid it altogether (see Helsing, 2007), because uncertainty is perceived as a lack of expertise while certainty reflects professionalism (see Sniezek & Van Swol, 2001). However, this is a potential pit-fall, because more knowledgeable persons are typically also more aware of their limits and options, as described by the Dunning-Kruger effect (1990). In other words, being uncertain about teaching might not necessarily imply that one is unprepared but may indicate a more complete grasp of the underlying complexity of subject and pedagogic knowledge. For instance, student teachers who have more pedagogical content knowledge (PCK) and/or more teaching experience might be more aware of the large number of instructional options available to them and more willing to address them.

Differences may also exist in how student teachers prefer to handle their uncertainties. Whereas some may seek guidance to help them deal with the uncertainty, other student teachers may prefer to receive solutions that resolve the uncertainty immediately. For example, Graham (1997) described how a student teacher expressed frustration with his mentor when he did not provide "direct advice and answers to the teaching dilemmas he identified" (p. 522).

3. Uncertainty in pre-lesson conferences

Mentoring dialogues (i.e., coaching interactions, see Hoffman et al., 2015) are an important component of the teaching practicum and lesson conferences are generally believed to present student teachers with learning opportunities (Blömeke et al., 2011; Futter, 2017). So far, the prevalent approach has been to assist student teachers through post-lesson conferences, in which the focus mainly lies on the evaluation of teaching actions in singular situations that went well or not so well (e.g. Feiman-Nemser, 2001). In contrast, pre-lesson conferences, as proposed by recent adaptations of the Lesson Study approach (see Cajkler & Wood, 2016) or the Content-Focused Coaching model (CFC; see West & Staub, 2003), focus on *collaborative* lesson planning, in which different ideas can be negotiated between student teachers and cooperating teachers (Staub, 2015). Thus, as both discuss the lesson plan, they may encounter situations where different solutions are possible. Therefore, pre-lesson conferences provide a good and realistic context to examine teaching uncertainties, in order to better understand the kind of support student teachers need to handle uncertainty productively.

4. Uncertainty as a learning opportunity

When individuals express uncertainty during a collaborative activity such as in pre-lesson conferences, opportunities arise for the types of social interactions that facilitate learning: probing, explaining, and generating alternative solutions, among others (e.g., Kapur & Bielaczyc, 2012). The resolution of uncertainty may also play an essential role in the learning process as data from a recent study by Rodriguez, Price, and Boyer (2017) on collaborative problem-solving dialogues suggests. Rodriguez and his colleagues found that both high- and low-performing pairs showed expressions of uncertainty, but high-performing pairs used these episodes as learning opportunities and actively resolved it.

In the context of teacher education, Pretorius and Westhuizen (2015) recognized the learning potential of uncertainty in collaboration and showed that when the mentor teacher signaled to be uncertain, student teachers were more likely to view knowledge as tentative too, leading to more exploration of ideas and potential learning. Pretorius and Westhuizen proposed that mentors can create a safe space for knowledge construction by showing so-called *ostensible uncertainty* (pretending to be uncertain, p. 181) as opposed to a more directive style. However, the question remains as to whether and how cooperating teachers can also use student teachers' *genuine uncertainty* productively in the flow of conversation to encourage learning.

4.1. Cooperating teachers' support

One way of understanding cooperating teachers' support during interactions about uncertainty with student teachers is to examine their communication style(s). Previous research focused on investigating one conversational aspect at a time to identify cooperating teachers' style, for instance, by examining variations in the amount of control accorded to the student teachers during interactions (e.g., Glickman, Gordon, & Ross-Gordon, 1998). Recently, Hennissen, Crasborn, Brouwer, Korthagen, and Bergen (2008) suggested examining overt aspects (e.g., topics addressed, duration, degree of directiveness) of mentoring dialogues simultaneously and developed to this purpose the two-dimensional model called *Mentor Teacher Roles in Dialogues* (MERID) to analyze mentoring behavior. This model connects two overt aspects of mentoring dialogues: the dimensions *input* and *directiveness* with two poles. The dimension "input" represents the degree to which the cooperating teacher

introduces topics into the dialogue and ranges from active to reactive, whereas the dimension of “directiveness” indicates the degree to which the cooperating teacher controls the course of the conversation and ranges from directive to non-directive. For example, cooperating teachers using conversational turns - by making suggestions - to bring in ideas have a more directive style than cooperating teachers who use their turns to elicit information from the student teacher - by asking clarification questions - because the latter motivates the student teachers to explain and reflect on their own ideas (Hennissen et al., 2008). Thus, the advantage of the MERID-model is that it allows a simultaneous investigation of two aspects of mentoring conversations that may provide a more differentiated analysis of cooperating teachers' communication style during uncertain moments.

4.2. Defining and operationalizing student teachers' learning

For this study's purposes, we were interested in both learning as outcome and process. We understood “learning as process” as the changes in student teachers' knowledge or understanding occurring moment-by-moment during uncertainty episodes. For instance, Futter (2017) used the MERID-model to analyze mentoring dialogues in lesson conferences and revealed that a communication style that is only moderately directive and provides the student teachers with opportunities to bring up topics themselves tends to lead to more learning opportunities. Importantly, Futter distinguished between learning opportunities with and without indications of learning. She considered indications of learning intentions to change/adapt the lesson plan during the lesson conferences as well as reflections on own actions.

Secondly, we were interested in “learning as outcome”, namely, whether it transfers to student teachers' instructional behavior. Thus far, most studies have focused on assessing student teachers' self-ratings of instructional quality (e.g., Cohen, Hoz, & Kaplan, 2013), usually pertaining to basic dimensions such as cognitive activation, efficient classroom management, or the clarity of instruction (Lipowsky et al., 2009; Van de Grift, Van der Wal, & Torenbeek, 2011). Surprisingly, even though pupils are important participants in the practicum process, little research has taken pupils' perceptions into account (see Hoffman et al., 2015). For this reason, in this study we included assessments of instructional quality reported by both student teachers and their pupils as a proxy for student teachers' instructional learning.

5. Present study

The overall aim of the study was to explore student teachers' uncertainties in pre-lesson conversations as well as how cooperating teachers' communicative style in response to these uncertainties might lead to learning opportunities and foster student teachers' instructional learning. More specifically, the study examined the following research questions:

1. What uncertainties do student teachers encounter in lesson planning and how are they resolved?
2. To what extent do student teachers' pedagogical content knowledge and teaching experience relate to how they express uncertainty?
3. How do cooperating teachers respond to student teachers' uncertainty?
4. To what extent does cooperating teachers' directiveness in response to uncertainty relate to student teachers' instructional learning?

We used a linguistic approach to capture uncertainty following the idea that an individual's experience of uncertainty can be revealed through language. Psycholinguistic studies have shown that speakers use hedges (“I guess”), modal auxiliaries (“I may”), indirect questions, hesitations and more pauses when they express uncertainty (e.g., Lakoff, 1973; Smith & Clark, 1993). At the same time, uncertainty language can serve also social purposes, for example, to do face work associated with politeness (Brown & Levinson, 1978). While we anticipated that some student teachers would use hedges as a sign of politeness due to the power imbalance, we were generally interested in how expressions of uncertainty were handled in the unfolding conversation. Based on Floden and Clark (1988), we expected uncertainties to arise related to pupils' prior knowledge and the instructional design, as well as the content of the lesson. Regarding the second research question and based on Kruger and Dunning (1999), we expected student teachers with more PCK and teaching experience to address more uncertainties on their own. The last two research questions were exploratory in nature, given the novelty of the topic.

6. Method

6.1. Study context

The present study used data from a larger research project that was carried out between 2009 and 2013 in the context of several teacher training institutions in the German speaking part of Switzerland. The aim of the project was to examine the impact of pre-lesson conferences and cooperating teachers' support on student teachers' competencies and pupils' learning during the teaching practicum. The student teachers participating in the project were preparing to become mathematics teachers at the lower secondary level (pupils aged 12 to 15) and were completing a subject-specific practicum in cooperating schools lasting a minimum of three weeks. The student teachers and the cooperating teachers were invited to participate in the project either via e-mails or during a regular information session about the compulsory practicum at their training institute. Thus, study participation was voluntary, and the sample consisted of motivated participants who were willing to invest extra time into the requirements of the study. In order to ensure that the lessons were comparable across the different settings, all student teachers were requested to cover a common topic (area and perimeter of rectangles and squares) during the third week of their practicum (comprising about three mathematics lessons).

6.2. Participants

The total sample consisted of 59 student teacher-cooperating teacher dyads. A subsample of 21 dyads additionally agreed to participate in a complementary video study that recorded the occurring pre-lesson, post-lesson conferences, and mathematics lessons for the same topic taught in the third week of the practicum. Since the analysis presented in this study focuses only on dialogues in pre-lesson conferences, seven dyads that only engaged in post-lesson conferences were excluded, resulting in data from 14 dyads as the final sample for the analysis.

At the time of the data collection, the 14 cooperating teachers were between 31 and 58 years old ($M = 48$, $SD = 8.6$, 86% male). Their general teaching experience ranged from eight to 36 years ($M = 20$, $SD = 9$) and their mentoring experience from one to 17 years ($M = 8$, $SD = 5$). The student teachers were 20–32 years old ($M = 24$, $SD = 3.93$, 43% male). On average, they were enrolled in the sixth semester ($SD = 1.3$) of their teacher education program and had completed, on average, 12 weeks of teaching practice in mathematics (min = 3, max = 27, $SD = 6.97$). Each student teacher selected one class for the study, involving a total of 258 pupils

($M_{age} = 13.80$, $SD = 1$, 49% female) with an average of 18.42 pupils per class ($SD = 5.74$).

6.3. Data sources and measures

6.3.1. Procedure

At the start of their practicum, the student teachers and their cooperating teachers completed a test measuring their PCK in mathematics and filled in a questionnaire with their personal information. At the end of each of the three lessons that were videotaped in the third week of the practicum, the student teachers were requested to fill in an online questionnaire with a scaled response format evaluating, among other things, the instructional quality of each mathematics lesson by means of several features (monitoring, classroom management, clarity, and cognitive activation). The short paper-based surveys for pupils evaluating the instructional quality of the lessons of that week were administered by the cooperating teachers (following the instructions of the research team) after the last mathematics lesson of that week. For an overview of the data sources see Fig. 1.

6.4. Qualitative measures

6.4.1. Video and transcript data

In total, 32 pre-lesson conferences were recorded (total speaking time 10.45 h). A pre-lesson conference had an average duration of 20.08min (min = 5 min, max = 42.2min). The pre-lesson conferences were mainly conducted in Swiss German dialects. The videos were transcribed into Standard German by assistants affiliated with the research project (see Futter, 2017). An effort was made to retain specific word use, as well as errors, repetitions, pauses, and overlaps. Intonation, speech rate, and other acoustic features were not transcribed as they were available from the video data.

The unit of analysis was the episode consisting of multiple turns dealing with the same semantic content (Van Dijk, 1982). A new turn begins the moment when an individual starts speaking and ends the moment someone else starts talking. The choice of turns and episodes as the units of analysis allowed scrutiny of the mentoring support. An uncertainty episode, thus, consisted of a sequence of turns in which an uncertainty was discussed.

6.4.2. Detecting ***uncertainty in pre-lesson conferences***

Our first step was to consult previous literature on uncertainty detection in tutoring dialogues based on English data (e.g., Litman & Forbes-Riley, 2006; Pon-Barry, 2008) and two studies investigating uncertainty in German spontaneous speech. For instance, Droessiger (2009) was able to show that German speakers also use nouns to communicate uncertainty, such as "Vermutung" (assumption) or "Möglichkeit" (possibility), and Schrank and Schuppler (2015) identified a set of detailed acoustic (e.g., pauses, speaking rate) and lexical features (e.g., hesitation particles, repetitions) that indicate uncertainty in spontaneous speech.

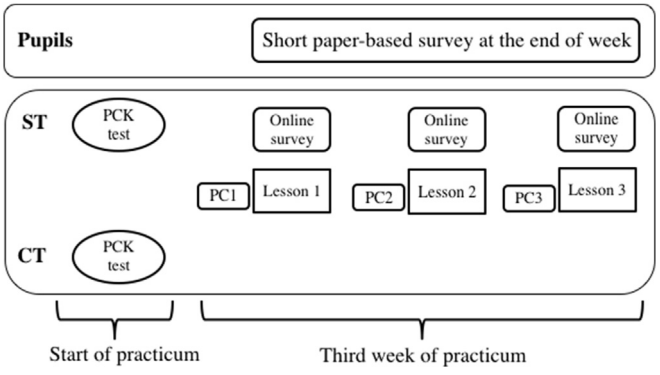

Fig. 1. Overview of the data sources used in the study. ST = student teacher, CT = cooperating teacher, PCK = pedagogical content knowledge, PC = pre-lesson conference.

However, most of the consulted studies were unsatisfactory to our purposes because they used linguistic features intended to be captured by a computer model. Since our study aimed to use uncertainty markers that could be quickly recognized by cooperating teachers in the flow of conversation, we limited our coding to more salient uncertainty features. For example, using the subjunctive mood ("I could") is cross-linguistically attested to express a speaker's lower certainty about their utterance compared to using the indicative mood ("I can") (Nuyts, 2001) and specifically for German, sentences starting with "ob" (whether) convey the idea that what is said is liable to doubt. Additionally, we considered the uncertainty markers used by cooperating teachers in the study of Pretorius and Westhuizen (2015) and we developed a coding scheme to detect uncertainty in pre-lesson conferences (see Table 1 for a description of the codes as well as examples). Importantly, we considered consistently longer pauses and interrupted speech to be a sign of raised cognitive load and, hence, a sign of uncertainty or indecision, because it suggested that the student teacher was considering different alternatives in the course of answering. In contrast, a person who is certain about their response would show a lower incidence of hesitation (Levelt, 1989).

6.4.3. Source of uncertainty

Following Floden and Clark (1988), the uncertainty episodes were assigned to a specific source of uncertainty (see Table 2), consisting of six categories: a) pupils' knowledge (when the uncertainty revolved around what pupils already knew), b) instructional design (when the uncertainty revolved around the classroom formats, such as individual work versus group work), c) instructional content (when the uncertainty revolved around the content such as choosing between different tasks), d) teacher authority (when the uncertainty revolved around student teachers' social authority in the classroom), e) practice improvement (when the uncertainty revolved around student teachers' ability to improve their teaching), and f) other (when the episode could not be assigned to any of the five sources described by Floden and Clark (1988)).

6.4.4. Uncertainty input and cooperating teachers' directiveness

We adapted the MERID model of Hennissen et al. (2008), and used the input dimension to analyze whether the uncertainty was triggered by an issue brought up by the cooperating teacher (active) or if it was raised by the student teacher, and responded to by the cooperating teacher (reactive). Secondly, the directiveness dimension was used to analyze cooperating teachers' conversational turns in response to student teachers' display of uncertainty. The dimension of directiveness was conceptualized as a continuum from non-directive moves to more directive moves (see Fig. 2 and Tables 3 and 4 for a description of the items as well as examples). The average directiveness score was computed by multiplying each type of move identified in the pre-lesson conferences by its rating (from 1 for least directive to 8 for most directive). These values allowed us to categorize cooperating teachers' styles for the dyads that held several pre-lesson conferences.

6.4.5. Indicators of learning in pre-lesson conferences

To capture uncertainty episodes that culminated in learning opportunities with indication of learning, this study used an existing coding protocol developed by Futter (2017). Futter considered statements ("This is actually a good idea") or gestures

Table 1
Coding scheme with examples used to identify uncertainty in pre-lesson conferences.

Category/Kappa	Code	Description	Example German (original)	Example English
Uncertainty_Linguistic/ .70	Conjunction	Use to code utterances containing a conjunction that signalizes that different options are possible or they occur before an expression of doubt	ST: Ob man das besser (-) mündlich macht (-) ja. Also es müssen auch alle sehr aktiv dabei sein.	ST: Whether it is better (-) to do it orally (-) yes. Then everyone has to be very actively involved.
	Adverb	Use to code utterances containing an adverb that expresses doubt or uncertainty, e.g. maybe, probably	ST: Und zwar möchte ich da wirklich vielleicht auch wirklich einmal mischen, so dass ein Schwächeres und ein Stärkeres zusammenkommen kann.	ST: Namely, I would like to maybe really mix it for once so that a weaker and a stronger [student] get together.
	Cognitive Verb (Smith&Clark, 1993)	Use to code utterances containing a cognitive verb, e.g. think, consider, believe	ST: Ich habe es ursprünglich so gedacht: Einzelarbeit aber einfach (–) vergleichen, und wenn es Probleme gibt, dann einander fragen.	ST: I had originally thought it like this: individual work but just (–) compare and if there are problems, they can ask each other.
	Noun (Droessiger, 2009)	Use to code utterances containing a noun that signalizes uncertainty or that options are still open, e.g. plan, assumption, question	ST: Das ist die Frage. Ob sie das in das Heft legen wollen und aus (-) zu Hause einkleben oder ob wir es gerade machen (-) es braucht ja nicht viel Zeit zum einkleben.	ST: This is the question. Whether they should place it in the notebook and (-) stick it in at home or whether we do it straight away (-) it doesn't take a lot of time to stick it in.
	Subjunctive (Hyland, 1998)	Use to code utterances containing a verb in subjunctive to signalize a possibility	ST: Ja, also (-) ich würde es ein bisschen ähm (-) geführt machen. Zuerst nur das Dreieck A (-) ähm das Viereck A.	ST: Yes, so (-) I would do it a little uhm (-) guided. First only triangle A (-) uhm rectangle A.
	Adjective (Hyland, 1998)	Use to code utterances containing an adjective that signalizes an uncertainty	ST: Und dann bin ich mir nicht ganz sicher, ob ich (-) ähm (-) die Angabe (-) wenn ich, wenn ich die Zeichnung mache, ob ich es eins zu eins angeben will (-) oder ob ich irgendwie (-) einen Massstab nehmen will.	ST: And then I am not entirely sure whether I (-) uhm (-) the indication (-) if I, if I make the drawing, whether I want to indicate it one-to-one (-) or whether I sort of (-) want to take a scale.
	Pause (Romigh et al., 2016)	Use to code long pauses	ST: Ja es wäre natürlich (4 Sek.) Ja, ich würde dann schauen, wie weit sind sie, oder.	ST: Yeah it would be of course (4 sec.). Yes, I would see how far they already are.
Uncertainty_Episode/ .64		Use to code an entire episode in which the ST is uncertain. The episode ends when the uncertainty is resolved or when the discussion turns to another topic	ST: Eben nachher habe ich eigentlich, ich weiss nicht, wegen der Zeit. Da wollte ich noch fragen, wie du das siehst. CT: = Ja (-) du hast acht Minuten für die Präsentationen, mhm? ST: Ist das zu wenig? (-) Ich denke es werden dann schon zehn. CT: Ja, Ich habe das Gefühl, wenn sie jetzt wirklich (-) ja, es sollte eigentlich schon reichen.	ST: Afterwards I have actually, I don't know about the time. Here I wanted to ask how you see it. CT: = Yes (-) you have eight minutes for the presentations, right? ST: Is it too little? (-) I think it could become ten. CT: Yeah, I have the feeling if they really (-) yes, it should actually be enough.

Note. ST = student teacher, CT = cooperating teacher. The hyphen (-) indicates a short pause.

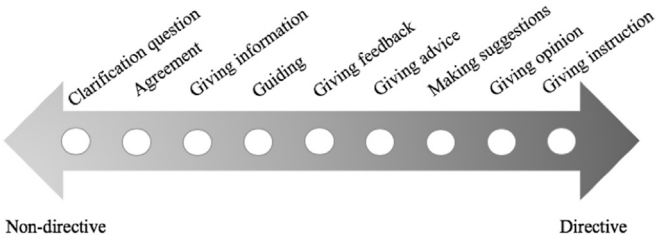

Fig. 2. The dimension directiveness and the categorization of cooperating teachers' responses (adapted from Hennissen et al., 2008).

(taking notes) that convey the intention to change/adapt the lesson plan during the lesson conferences as well as reflections on own actions (when the student teachers explained his/her plan or reflected on a certain lesson situation and presented alternatives) as indication for learning. In the pre-lesson conferences, student teachers' notes taking usually occurred after feedback or information from the cooperating teachers, and we considered it to be an indication that the student teachers were going to consider the suggestions.[2]

[2] We cannot fully exclude the possibility that the student teachers were taking notes or made specific statements as a result of the asymmetrical relationship leading to social desirability; in other words, it is possible that some student teachers took notes with the intention to integrate the suggestions made by their cooperating teacher because they wanted to please him or her and not because of a change in their knowledge or beliefs.

6.4.6. Coding procedure

The transcripts were coded while viewing the video recordings in order to account for non-verbal aspects such as intonation and gestures (see Dijkstra, Krahmer, & Swerts, 2006). The start of an uncertainty episode was identified when the turn of the student teacher contained at least one uncertainty indicator (see Table 5 for an example of a coded transcript excerpt). However, because such markers can function in multiple ways, we did not code every single conjunction (e.g., "whether") uttered by a student teacher in isolation, but rather we determined at the discourse level whether a statement was uncertain or not – a verbal expression cannot be assessed without taking the context and the communication situation into account (see Liscombe, Riccardi, & Hakkani-Tür, 2005).

Then, the first turn was coded for input and each cooperating teacher's turn was assigned to one of the moves from the continuum of directiveness until the uncertainty was resolved or the discussion turned to a different topic. For example, if the student teacher uttered "Aha, okay" or "This is actually a good point" this was considered as an indication for the end of the uncertainty episode. Consequently, student teacher uncertainty was assessed by measuring the duration of the uncertainty episodes for each pre-lesson conference.

A second coder examined ten percent of the data individually and then compared her annotations with the first author and discussed disagreements. Most of these were resolved successfully, though there continued to be differences with regard to when an episode ended. Following the first session, two other pre-lesson conferences were coded independently and inter-rater reliability

Table 2
Sources of uncertainties (based on Floden & Clark, 1988).

Source of uncertainty	Description	Example
Pupils' (prior) knowledge	Uncertainty about pupils' (prior) knowledge and understanding	ST: Is it okay like this? I still have this one question. Have they already learned it with brackets (–) do they know?
Instructional design	Uncertainty about classroom formats, type of activity, verbal and visual information	ST: Here I don't know if I should let them try it each by themselves or if they should do it again in pairs?
Instructional content	Uncertainty about what content to cover	ST: And now comes the question, I do the first one for sure. But this one here [an exercise], I am not sure whether this confuses them more.
Teacher authority	Uncertainty about the teacher's role as a social authority in the classroom	NA
Practice improvement	Uncertainty about teachers' own capacity to improve their teaching	NA
Other	Uncertainty about topics that could not be assigned to the other categories	ST: I don't know. This is something that feels a little suspicious to me. Because on the one hand a six (i.e. highest grade) is just perfect but on the other hand, yeah, I don't know.

Note. ST = student teacher. The double hyphen (–) indicates a longer pause. NA indicates that this source was not encountered in the pre-lesson conferences.

Table 3
Coding scheme used to code uncertainty input.

Category	Code/Kappa	Description	Example German (original)	Example English
Uncertainty_Input	CT_Reactive/.81	The ST expresses the uncertainty him/herself	ST: Und jetzt ist die Frage, also das Erste mache ich sicher. Aber dieses hier, ob sie das (–) nicht mehr verwirrt.	ST: And now comes the question, so the first one, I do this for sure. But this one here, whether this (–) doesn't confuse them more.
			CT: Aber von dieser Seite anzuschauen wäre eben schon noch spannend.	CT: But to look at it from this perspective would be in itself interesting.
			ST: Eben.	ST: Precisely
			CT: Es ist wirklich beides, ich würde beides bringen.	CT: It's really both, I would bring in both.
	CT_Active/.85	The CT asks a question that triggers ST's uncertain reaction	CT: Schreibst du diese an?	CT: Are you going to write these down?
			ST: Würdest du diese nicht anschreiben?	ST: Wouldn't you write them down?
			CT: Ja, das wissen sie, also wenn du sagst, sie wissen sehr viel, wieso	CT: Yes, they know this, so if you say they know a lot, why
			ST: Dann schreibe ich diese dann an.	ST: Then I'll write these down.

Note. CT = cooperating teacher, ST = student teacher.

Table 4
Coding scheme used to code cooperating teachers' responses to uncertainty (based on Hennissen et al., 2008).

Category	Code/ Kappa	Description	Example German	Example English
CT_Moves	CT_Question/ .82	The CT asks a clarification question	CT: Was heisst um das Vergleichen der Vierecke?	CT: What does it mean the comparison of rectangles?
	CT_Agreement/ .90	The CT agrees with an idea or a plan	CT: Genau, ja. Das ist so.	CT: That's right, yeah. That's how it is.
	CT_Information/ .75	The CT provides information without giving any indications of what should be done	CT: Äh (-) das haben sie sogar gehabt. Das kennen sie schon.	CT: Uhm (-) they've even had this. They know it already.
	CT_Guiding/ .80	The CT gives a guiding response or asks a guiding question	CT: Wie könnte man dem dann entgegenwirken? Dass du nachher alle trotzdem am (-) am gleichen Ort hast? Wie hast du dir das überlegt?	CT: How could you prevent that? So that you still have everyone (-) in the same place? What do you have in mind?
	CT_Feedback/ .75	The CT gives feedback (positive or negative)	CT: Also der Anfang jetzt erste Lektion gefällt mir.	CT: I like the start of this first lesson.
	CT_Advice/ .70	The CT gives advice	CT: Also wiederum die Lernenden einfach miteinbeziehen.	CT: So, again, simply include the learners.
			ST: Mhm.	ST: Mhm.
			CT: Möglichst immer wieder und (-) dass sie einander gegenseitig Tipps geben können.	CT: Preferably again and again and (-) so that they can give each other tips.
	CT_Suggestion/ .85	The CT suggests something	CT: Ja. Vielleicht könntest du auch eine Linie hineintun.	CT: Yes. Maybe you could also add a line.
	CT_Opinion/ .78	The CT gives his/her opinion	CT: = Ja, gut, also das hier finde ich jetzt fast (-) zu simpel.	CT: = Yeah, okay, I find this almost (-) too simple.
	CT_Instruction	The CT gives direct instruction	NA	NA

Note. CT = cooperating teacher, ST = student teacher. The hyphen (-) indicates a short pause. NA indicates that this source was not encountered in the pre-lesson conferences.

was assessed using Cohen's kappa statistic. The values obtained ranged between 0.64 and 0.90, and were deemed sufficient for the present study. We obtained lower reliability scores (0.64) for the resolution of uncertainty, as it was sometimes difficult to assess whether the uncertainty was indeed resolved to student teachers' satisfaction, reflecting the ambiguity of the coding scheme in this

Table 5
Example of coded transcript.

Uncertainty episode	Uncertainty cues	MERID dimensions	
		Input	Directiveness
CT: Uhm, you give that to them right away to stick it (the drawing) onto their notebook, right? As an example.	Start of uncertainty episode	Active (CT's question elicits ST's uncertainty)	
ST: You would give it to them right away to stick it on? I actually thought for them to simply discuss it.	Adverb (used to emphasize surprise), cognitive verb (used to communicate a supposition)		
CT: Or discuss. Yes, see how it comes out. I was thinking, then they'll have it in the theory part right away.			Opinion
ST: Okay, so this would be afterwards. And then we go on to the next one, there aren't a lot of exercises.	End of uncertainty, resolution without indication of learning		

Note. CT = cooperating teacher, ST = student teacher.

area (see Discussion).

6.5. Quantitative measures

6.5.1. Pedagogical content knowledge test

The PCK-test was taken from the COACTIV-study which was embedded in the 2003/2004 cycle of the German national component of the PISA study that surveyed and tested various aspects of mathematics teachers' competence. The original PCK-test focused on three different dimensions (for example tasks and psychometric properties see Krauss et al., 2008): knowledge of mathematical tasks (11 tasks), knowledge of student misconceptions and difficulties (7 tasks), and knowledge of mathematics-specific instructional strategies (4 tasks). In this study, a short version of the test (eight tasks) with an open-ended response format was employed with a possible total maximum score of 14. The cooperating teachers and student teachers were given 30 min to complete the test. The tests were rated by two advanced mathematics student teachers. Based on the double coding of ten PCK-tests (five from cooperating teachers and five from student teachers) a satisfactory interrater-reliability was established ($\kappa = 0.80$).

6.5.2. Instructional quality

Four aspects of instructional quality, namely *monitoring*, *classroom management, clarity of instruction,* and *cognitive activation* were assessed at the end of the third week of the practicum with scales from the TIMSS project (an international comparative study of student achievement, see e.g., Bos, Wendt, Köller, & Selter, 2012) and the COACTIV research project (see e.g., Kunter et al., 2007). The student teachers and the pupils evaluated the mathematics lessons by rating a total of 17 items on a 4-point Likert scale ranging from 1 = completely disagree to 4 = completely agree. For example, to assess the *cognitive activation,* student teachers answered the question: "How well have you succeeded in encouraging the pupils to think and collaborate in today's mathematics lesson?" and their pupils rated the statement: "This week, in our mathematic lessons, the student teacher encouraged us to ask questions". Two student teachers failed to fill in the online questionnaire and four student teachers only completed it for one lesson, therefore for those cases single entries were used in the analysis. Reliability was computed for the total sample ($N = 59$ student teachers and $N = 1000$ pupils) and Cronbach's alpha ranged between 0.75 and 0.79, indicating sufficient reliability for the subscales. The average score across the four subscales was used as a proxy for student teachers' instructional learning.

6.6. Data analysis

Since this study aimed to gain insight into specific processes of a phenomenon in a real-life context, a qualitative methodology (Merriam, 1998) was chosen to answer the research questions. A multiple case study method was adopted because this approach allows an exploration within each case and across cases to understand similarities and differences in cooperating teacher-student teacher interactions (Yin, 1989). The unit of analysis included three levels: the dyad level (the case), the pre-conference level (first subunit), and the episode level within pre-conferences (second subunit). The procedures for data analysis were drawn mainly from the work of Merriam (1998) and Yin (1989) and the analysis process consisted of four stages (see Fig. 3). Data coding and analysis was performed using the software MAXQDA 12.

7. Findings

7.1. Uncertainty in pre-lesson conferences

A total of 78 episodes of uncertainty (total duration 1.54 h) were identified in pre-lesson conferences, meaning that, on average, about 18% of talking time was spent discussing an uncertainty. Table 6 presents an overview of the duration of the pre-lesson conferences and the uncertainty episodes as well as the

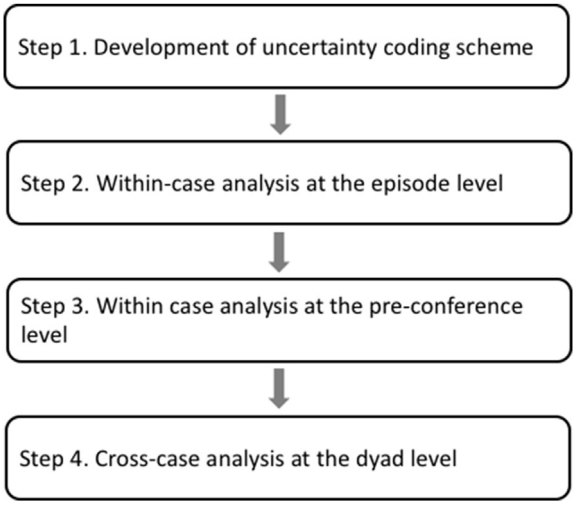

Fig. 3. Steps involved in data analysis.

Table 6
Overview per dyad of episodes and proportion of uncertainty, uncertainty input, and student teachers' individual characteristics.

	Uncertainty in pre-lesson conferences							Uncertainty input		Individual characteristics	
Dyad	Total duration PCs	Total duration uncertainty episodes	Total number of uncertainty episodes	Proportion uncertainty time in PCs	PC1	PC2	PC3	ST	CT	ST teaching experience (in weeks)	ST PCK
A	0:32:39	0:09:11	11	28%	5 (32%)	6 (26%)	-	55%	45%	15	3
B	1:13:20	0:14:38	10	20%	8 (33%)	2 (8%)*	-	60%	40%	7	5
C	0:48:29	0:16:54	9	35%	8 (57%)	1 (12%)	0%	33%	67%	3	4
D	1:34:23	0:21:54	18	23%	9 (25%)	7 (21%)	2 (26%)	89%	11%	20	8
E	0:15:03	0:03:45	2	25%	2 (25%)**	-	-	100%	0%	19	10
F	0:31:52	0:00:00	0	0%	0%	0%	0%	-	-	35	11
G	0:27:11	0:01:35	1	6%	-	1 (9%)	0%	100%	0%	16	9
H	0:26:31	0:02:18	4	9%	4 (9%)*	-	-	25%	75%	11	6
I	1:02:35	0:06:51	5	11%	3 (9%)	2 (23%)	0%	100%	0%	25	12
J	0:28:35	0:08:21	3	29%	1 (22%)	2 (34%)*	-	67%	33%	24	6
K	0:46:35	0:17:55	9	39%	4 (23%)	5 (55%)*	-	100%	0%	9	3
L	0:56:30	0:02:14	1	4%	0%	1 (21%)	0%	100%	0%	17	9
M	0:33:38	0:02:11	1	7%	0%	1 (12%)*	-	100%	0%	16	7
N	1:07:09	0:07:12	4	11%	1 (12%)**	0%	3 (13%)	100%	0%	17	6

Note. ST = student teacher, CT = cooperating teacher, PCK = pedagogical content knowledge, PC = pre-lesson conference. * = double-lesson, that is 1st and 2nd or 2nd and 3rd lesson were discussed together; ** = 1st/2nd/3rd lesson were discussed together, but single lessons were taught. For each pre-lesson conference, the absolute number of uncertainty episodes are presented and between brackets, the proportion of time spent on discussing the uncertainty episodes.

proportion of talking time spent on discussing uncertainty during the pre-lesson conferences for each dyad. On average, the dyads spent 5 min and 14 s discussing an uncertainty (min = 1.35min, max = 14.43min). In dyad F, the student teacher exhibited no sign of uncertainty. Furthermore, Table 6 shows that some dyads discussed fewer uncertainties at the time of the second pre-conference lesson (e.g., dyad C), whereas others addressed more uncertainties (e.g., dyad K and J).

7.2. Sources of uncertainty

The first research question concerned what uncertainties student teachers experience in lesson planning and how they handle them. The most commonly recurring uncertainty source revolved around instructional design (42 episodes), followed by instructional content (29 episodes). In four episodes, the dyads discussed concerns about pupils' knowledge, and in three episodes they addressed uncertainties related to test assessment (category "other"). Uncertainties about teacher authority and practice improvement were not addressed.

Regarding how the dyads handled the uncertainty, determining whether the uncertainty episodes were indeed resolved proved difficult sometimes. That is, according to the coding scheme, an uncertainty episode was considered to end the moment the conversation turned to another topic or the student teacher expressed his or her agreement with a proposed solution. Using this definition, 76 out of 78 uncertainty episodes were considered to be ended and resolved. However, in 3 out of 8 episodes coded together with the second rater, there was disagreement over when the episode actually ended and whether the uncertainty was indeed resolved. One explanation for this disagreement could be the fact that *uncertainty* was never discussed on a meta-level in the pre-lesson conferences, as there was a complete absence of the word "uncertainty" or its synonyms in all conversations.

7.3. Relationship of PCK and teaching experience with uncertainty manifestation

The second research question concerned the relation between student teachers' individual characteristics and the way they addressed uncertainty. The analyses revealed that in about 80% ($SD = 0.28$) of uncertainty episodes, student teachers voiced the uncertainty themselves while the remaining uncertainty was elicited by an utterance of the cooperating teacher. Fig. 4 shows the proportion of uncertainty source and who introduced it. Cooperating teachers' questions leading to student teachers' manifestation of uncertainty addressed more often issues of design (21%) than content (6%), while the student teachers were on average equally concerned with the design (33%) and the content (31%). This may be explained by the fact that decisions about the lesson content depend on pupils' prior knowledge and given that the student teachers were teaching a new class, they might have lacked information regarding this prior knowledge.

Student teachers had a PCK-mean score of 7.1 (max = 12, min = 3, $SD = 2.87$) and an average teaching experience of 17 weeks (max = 35, min = 3, $SD = 8.09$). Importantly, there was a positive correlation between the two variables ($r = 0.73$, $p = 0.003$). From the data in Fig. 5, it can be seen that student teachers with below average PCK-scores were more uncertain compared to student teachers with PCK-scores above average, suggesting that for them the uncertainty was related to a lack of knowledge. Less knowledgeable student teachers used linguistic cues of uncertainty such as "actually" or "I just thought" and their speech was often self-interrupted and accompanied by longer pauses. Interestingly, more experienced student teachers appeared to display almost as many uncertainties as less experienced student teachers (Fig. 6). However, the more knowledgeable and experienced student

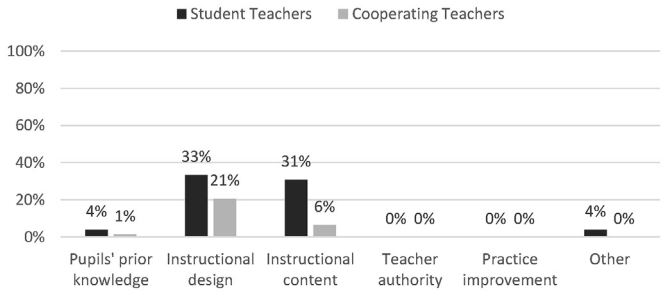

Fig. 4. Proportion of uncertainty source introduced by student teachers or cooperating teachers.

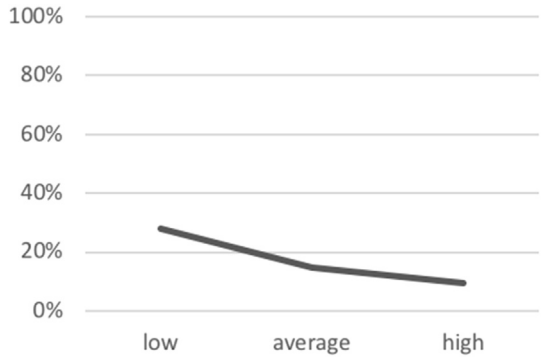

Fig. 5. Association between student teachers' PCK scores (x-axis) and the average proportion of uncertainty episodes (y-axis).

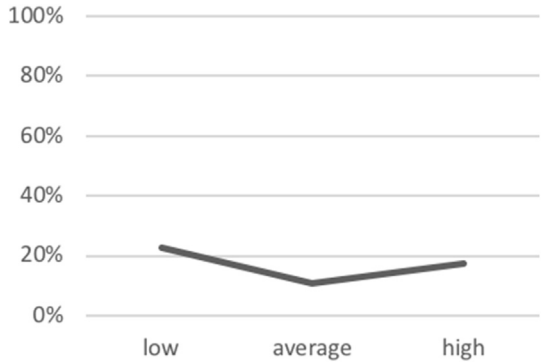

Fig. 6. Association between student teachers' teaching experience (x-axis) and the proportion of uncertainty episodes (y-axis).

teachers tended to introduce the uncertainty themselves more often, as illustrated in Figs. 7 and 8, respectively. This suggests that in their case, the uncertainty originated from an awareness of different possibilities that they may have experienced during the actual enactment of lessons, which was also apparent in the words and expressions they used to address an uncertainty ("I wonder", "perhaps", or "the question is").

7.4. Cooperating teachers' responses to uncertainty

The third research question concerned the directiveness of cooperating teachers' responses offered to student teachers' uncertainty. On average, cooperating teachers' answers consisted of

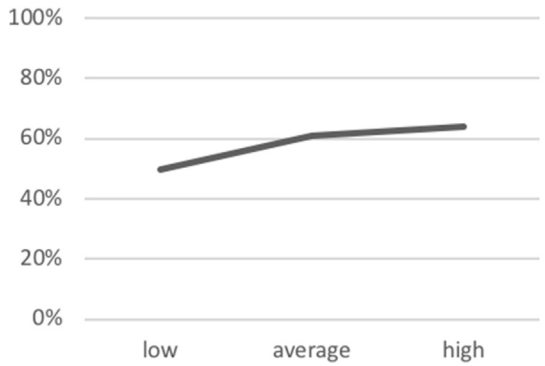

Fig. 7. Association between student teachers' PCK scores (x-axis) and the average proportion of uncertainty input (y-axis).

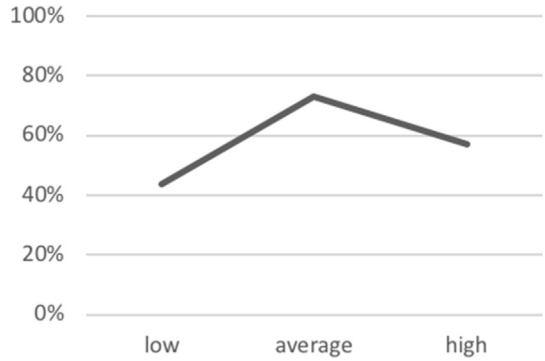

Fig. 8. Association between student teachers' teaching experience (x-axis) and the average proportion of uncertainty input (y-axis).

giving information (22%), providing guidance (18%), making suggestions (17%), and giving one's own opinion (14%). The other responses included agreement (13%), giving feedback (7%), and giving advice (5%). Only 2% of the responses involved clarification questions and no evidence of giving direct instruction was identified. Furthermore, the scatterplot in Fig. 9 shows that there was a trend for cooperating teachers to provide more directive responses to student teachers' uncertainty when these had more teaching experience. By contrast, this relation was non-existent for PCK (Fig. 10), which may be explained by the fact that cooperating teachers have more information about the teaching experience of the student teachers whereas their PCK becomes evident over time.

7.5. Generating instructional learning from uncertainty

The last research question concerned the relation between

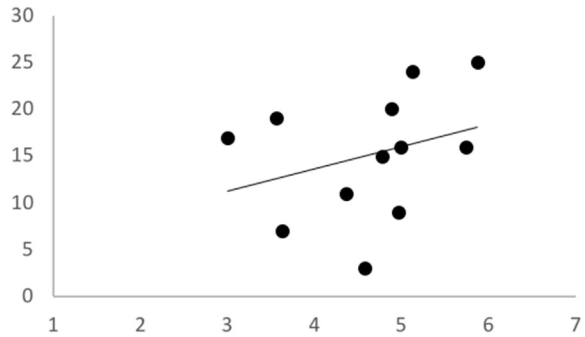

Fig. 9. Scatter plot showing the association between cooperating teachers' average directiveness (x-axis) and student teachers' teaching experience (y-axis), with linear trendline fitted.

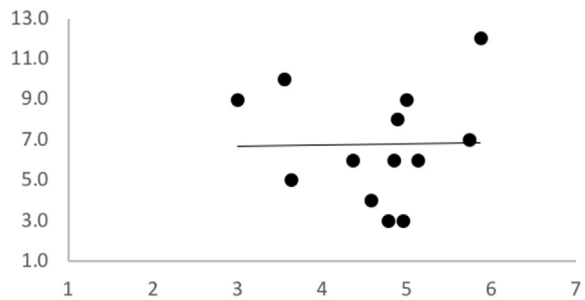

Fig. 10. Scatter plot showing the association between cooperating teachers' average directiveness (x-axis) and student teachers' PCK (y-axis), with linear trendline fitted.

Table 7
Cooperating teachers' directiveness and student teachers' instructional learning.

Dyad	CT Average Directiveness	Proportion uncertainty episodes with learning indicators	Instructional Quality	
			ST	Pupils
A	4.78 (.47)	36%	3.16	3.41 (.37)
B	3.63 (.11)	80%	3.18	3.41 (.27)
C	4.58 (.40)	33%	-	3.05 (.24)
D	4.90 (.50)	44%	3.70	3.23 (.59)
E	3.56 (.10)	0%	3.40	2.45 (.63)
F	-	-	3.14	3.07 (.46)
G	5.00 (.55)	80%	3.88	3.15 (.35)
H	4.36 (.34)	75%	2.96	3.62 (.21)
I	5.88 (.81)	40%	3.27	3.02 (.29)
J	5.14 (.58)	67%	3.42	2.73 (.22)
K	4.96 (.52)	78%	3.17	2.73 (.30)
L	3.00 (.09)	80%	-	3.06 (.48)
M	5.75 (.78)	0%	3.46	2.51(.44)
N	4.86 (.49)	75%	-	3.28 (.33)

Note. CT = cooperating teacher, ST = student teacher. Cooperating teachers' communicative moves were rated by their level of directiveness (clarification questions − 1, opinion − 8) to calculate an average across pre-lesson conferences. Standard deviations are given between brackets.

cooperating teachers' directiveness and student teachers' instructional learning. Focusing first on student teachers' cognitive level of learning, the third column in Table 7 presents the proportion of uncertainty episodes per dyad in which student teachers showed indication of learning. The numbers ranged from 0% to 80%, showing high variability across dyads. Regarding student teachers' instructional learning, Table 7 also includes the instructional quality of student teachers' lessons. On average, the instructional quality was deemed good by both the pupils ($M = 3.05$, $SD = 0.34$) and the student teachers ($M = 3.34$, $SD = 0.27$), with the exception of some few cases in which the pupils rated the quality as being notably lower or higher than the corresponding self-reports of the student teachers.

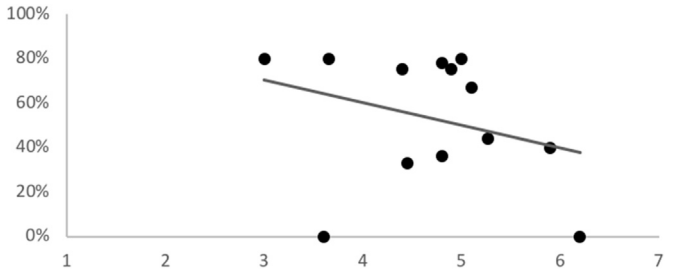

Fig. 11. Scatter plot showing the association between cooperating teachers' average directiveness (x-axis) and student teachers' proportion of indication of learning during uncertainty episodes (y-axis), with linear trendlines fitted.

A pattern between cooperating teachers' directiveness in response to uncertainty and student teachers' instructional learning was not clearly distinguishable. The scatterplots in Fig. 11 (presenting the cognitive instructional learning) and Fig. 12 (showing the behavioral instructional learning) suggest that there was a trend for student teachers to show fewer indications of learning when the cooperating teachers responded in a more directive way to their uncertainty, but what they also illustrate is evidence of variations in the type of support and learning outcomes.

7.6. In-depth qualitative analyses

In order to better understand the varying relations between cooperating teachers support during uncertainty episodes and student teachers' instructional learning, a more focused analysis of the noticeable cases that emerged during the first analysis was conducted using cross-case comparisons. The remainder of this section presents the findings from five cases which were chosen to illustrate similarities and differences in how uncertainties were manifested and handled by the cooperating teachers, and how these different ways of dealing with uncertainty may be related to student teachers' instructional learning. Specifically, dyads F and I were chosen for comparison because the student teachers had similar characteristics (in terms of PCK and teaching experience) but presented different ways of handling uncertainty. The example of dyad N was provided to point out how cooperating teachers can help student teachers handle the inevitability of uncertainty in teaching. Finally, dyads B and E were contrasted because both cooperating teachers showed a rather non-directive style in response to student teachers' uncertainty but used the resulting learning opportunity differently.

7.6.1. Ways of dealing with uncertainty

During the first analysis, student teacher F stood out as the only one who did not display any uncertainty. When considering his PCK and teaching experience, he was very similar to student teacher I. Both of them had considerable teaching experience (>25 weeks) and higher PCK scores than their cooperating teachers. However, despite sharing similar traits and in line with Helsing (2007), these two student teachers seemed to have very different ways of dealing with uncertainty. The responses of student teacher F to the questions of his cooperating teacher were very confident, as illustrated below. He never stated that he felt unsure about a particular aspect of the lesson and although the cooperating teacher asked several questions that encouraged experimentation with alternative

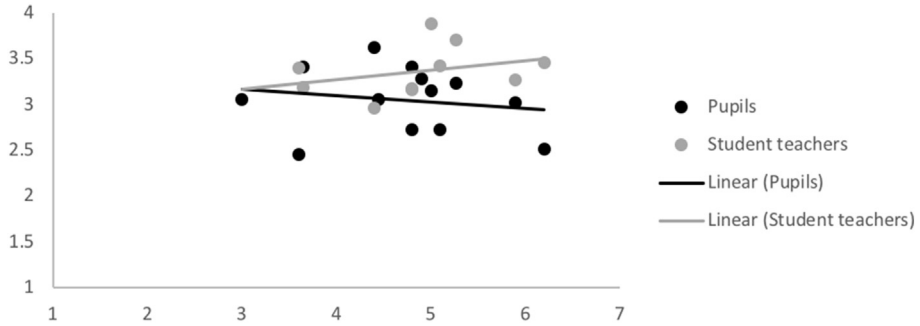

Fig. 12. Scatter plot showing the association between cooperating teachers' average directiveness (x-axis) and student teachers' instructional quality (rated by themselves and the pupils, y-axis), with linear trendlines fitted.

outcomes, the student teacher always provided a quick explanation, thus shutting down the opportunity to explore different possibilities.

Dyad F
CT: Do they all have a chance? Do all pupils have a chance here?
ST: They will certainly all have a chance today. So, one exercise is really differentiated. Because it is about finding the rectangles. There are clearly pupils who still won't find them, who will only find some of them.
CT: Yes, I'm asking because do you remember last week, you sometimes had the feeling that it didn't really work out as you wanted to.
ST: But they will find some [solutions] and that is an achievement. But the good pupils, those who are better, will perhaps see the system behind it. And then they can quickly write down all the solutions that fulfill the conditions.
CT: Yeah, if you keep this in mind, it's fine.

Student teacher I, on the other hand, showed that even with more knowledge and experience, teaching content and practices can still be questioned. He was generally confident about the design of his lessons, given his high experience, and mainly addressed his uncertainty regarding the instructional content in relation to pupils' knowledge, expecting his cooperating teacher to have a better estimation of this, as the latter was more familiar with the class.

Dyad I
ST: I'm wondering now whether this here [an exercise] is too difficult: "Find preferably simple terms for the area and perimeter. The entire rectangle is composed of different parts."
CT: So, the entire rectangle is (interrupted).
ST: Is easy.
CT: Is relatively easy. And the different parts, I think this is still difficult.
ST: Yeah, especially … how wide is this? Three *h*.
CT: Mhm, I wouldn't do it. This is obviously *s* and this is also *s* and this should be 0.4 then. And this is *s* and zero point … I wouldn't put it in.
ST: Yes, this is weird.

These two examples highlight how different student teachers' attitudes to teaching uncertainties can be and how these attitudes may hinder or promote the exploration of new ideas. Therefore, helping student teachers develop a positive relationship with uncertainty and acknowledge its inevitability in teaching, while also regard it as a learning opportunity is something that cooperating teachers could try to work on. How this can be done can be seen in an uncertainty episode of dyad N (see below). What is noticeable here is that the cooperating teacher recognized the difficulty while honestly admitting that she was not sure about the outcome and suggested to the student teacher to simply "see what happens". In doing so, she not only helped the student teacher recognize the uncertainty but she also showed him how to handle it.

Dyad N [shortened transcript]
ST: And here I'm wondering whether this [an exercise] makes sense.
CT: Ah no, this is for example, you can do here the area of this rectangle, eight, hm?
ST: Precisely, so that it appears somewhere, I find it important.
CT: Yes. Or it's confusing, you know, maybe you're confusing them. Perhaps … mhm. I wouldn't say a lot about the area. The exercise says 10 cm and the area of the rectangle is one to two to … you just have to say the largest is four times larger than the smallest.
ST: Do you mean this would rather interfere with the task?

(*continued*)

Dyad N [shortened transcript]
CT: This is now a good observation, I don't know. I would say, you're already constraining a little. I'd leave it open.
ST: Okay.
CT: You know, it would be nice if they, if we see, ah they are doing it now, they are concentrating on the length.
ST: Mhm, mhm.
CT: But then you would ask what is it actually about? It is about the area and afterwards … I would leave it open for the moment.
ST: Okay, thank you. This is good.

7.6.2. Cooperating teachers' directiveness and student teachers' instructional learning

A comparison between dyads B and E indicated that adopting a non-directive style to encourage student teachers to *talk more* might not be enough to ensure successful use of learning opportunities arising from uncertainty moments. For instance, the conversation presented below was filled with long pauses. Student teacher E voiced his uncertainty about the instructional content of the lesson and seemed to expect input from his cooperating teacher, but the latter was waiting for the student teacher to continue, and at the end it was not clear if the uncertainty regarding whether to use an algebra exercise was indeed resolved or not.

Dyad E
ST: I don't know exactly now, I just noticed that they are not very strong in algebra.
CT: Yes.
ST: Would it be a possibility for them to become acquainted with it?
CT: Mhm.
ST: When I was still in school it actually made sense to me. How can one calculate 39 times 29? 30 times 29 and times 30 minus 1.
CT: Mhm.
ST: Or so (6s).
CT: This would be relatively new.
ST: Yes, yes.
CT: We worked on this intensively, not with negative numbers but with the binomial theorem for rectangles.
ST: Yes.
CT: But you could start again here. Pick up at this point.
ST: Okay.
CT: And after that we take a look at (interrupted).
ST: In this case the exercises would have to revolve around rectangles, right? A plus B squared.
CT: Yes, yes. But they haven't learned it with the negatives. A plus B times A minus B.
ST: Mhm.
CT: Yes.
ST: Okay (3s).

When looking at cooperating teacher B, what stood out was also his non-directive style throughout the lesson-conferences, aimed at letting the student teacher address her own concerns. However, cooperating teacher B also addressed issues that his student teacher was not aware of, and then guided her to reflect on the difficulties he anticipated. Furthermore, the excerpt below shows that when the student teacher misunderstood the guidance as an indication to leave the exercise out completely, the cooperating teacher intervened in a more directive way, suggesting how to counteract the difficulty. Hereby, the uncertainty was resolved and the explanation the student teacher provided at the end suggests that she was now prepared for this alternative outcome.

Dyad B
CT: Mhm. How do you get here?
ST: To this answer?
CT: To the square. How are you going to address it? Do you have a certain way in mind? Or are you going to leave it to chance?
ST: I just, so I thought that we don't discuss it in advance. Depending on how … yeah, so rather the chance. Or do you think … ?
CT: There will be some pupils who will perhaps say that a square is a rectangle.
ST: Huh but that's right, the square is a rectangle. Would you rather leave it out?
CT: To avoid any misunderstandings: you could discuss the rectangle.
ST: Mhm.
CT: And then indicate that the square is a special case of the rectangle.
ST: Yes. Because all four sides are equal. And for a rectangle the opposite sides must be equal so then it can have two sides of different lengths (takes notes).

Taken together, these examples suggest that no single directive or non-directive communicative approach in response to uncertainty leads to successful learning - rather, it is important that cooperating teachers try to raise awareness of uncertainties and accommodate their support accordingly to ensure successful use of learning opportunities arising from uncertainty.

8. Discussion

This qualitative study draws attention to the importance of student teachers' uncertainties in lesson planning in relation to cooperating teachers' support and student teachers' instructional learning during their teaching practicum. Uncertainty was found to open up useful learning opportunities, suggesting that student teachers can benefit from cooperating teachers' conversational vigilance to identify and address uncertainty in order to foster learning.

8.1. Addressing uncertainty in pre-lesson conferences

Pre-lesson conferences provided a good context to discuss uncertainties as the evaluative aspect seemed to be less accentuated and it created an atmosphere in which student teachers felt safe to bring in own doubts and uncertainties (80% of uncertainties were voiced by student teachers). This finding highlights the importance of pre-lesson conferences as an appropriate setting for discussing realistic situations that model the uncertainty of the actual practice and help to prepare student teachers to better anticipate difficulties.

The current study adopted an innovative approach to capture uncertainty in real-time mentoring conversations, using linguistic markers such as adverbs (e.g., perhaps), nouns (e.g., assumption), or conjunctions of condition (e.g., if) that convey doubt or an indecision, as well as prosodic cues (long frequent pauses). From a research perspective, using such cues is a promising method as compared to other approaches commonly used in the teacher literature (i.e., self-reports). As it is a rather implicit measure, it makes it less prone to report bias, since many of these linguistic features are not easy to consciously control. Furthermore, researchers do not need to disrupt the ongoing discussion, which makes this approach more ecologically valid. From an educational perspective, the study contributes to our understanding of how student teachers' uncertainty is revealed in their language. Training cooperating teachers to pay close attention to uncertainty speech cues could help to seize more opportunities to engage in a constructive dialogue.

Interestingly, the word *uncertainty* itself or any of its synonyms were not used neither by student teachers nor by cooperating teachers although uncertainties were implicitly discussed. If uncertainty is not explicitly mentioned in lesson planning, it is likely that student teachers will continue to feel that the uncertainties they experience are anomalous. Therefore, cooperating teachers could try to directly address issues of uncertainty by explicitly asking "Do you have any uncertainties?". In addition, cooperating teachers could point out to student teachers who may perceive uncertainty as a threat and/or believe that it is all about being confident and having the "right" answers that the aim of lesson *planning* is to explore and prepare for various possible outcomes, and that being uncertain is part of the profession.

8.2. Sources and awareness of teaching uncertainty

In our sample, most uncertainties revolved around the instructional design and content of the planned lesson. Interestingly, teacher authority and practice improvement were not a topic of uncertainty. However, it is possible that these sources of uncertainty become more relevant to student teachers after the lesson. Further studies could investigate student teachers' uncertainties in post-lesson conferences to see if this yields different findings. With respect to the resolution of uncertainty, it was often difficult to determine whether the uncertainty was resolved, which we attribute to a lack of meta-communication within dyads. An implication for cooperating teachers is to make sure that the uncertainty is indeed clarified, for instance by asking the student teachers how they intend to incorporate their reflections into the lesson plan.

We focused on the pedagogical content knowledge of student teachers and their teaching experience to understand whether these two characteristics may relate to the way student teachers handled the uncertainty. The findings suggested that, for our sample, student teachers with more teaching experience and more pedagogical content knowledge were more likely to initiate discussion related to their uncertainties. This reinforces the idea that being uncertain is not always an indication of lack of knowledge, but it could also originate from a more adequate awareness of one's limits and options, in line with Kruger and Dunning (1999). Recognizing these different sources of uncertainty improves our understanding of uncertainty in teacher education and can help to inform teacher educators of the different needs of student teachers and the opportunities they should be provided with to carefully support their dealing with uncertainty.

8.3. Transforming uncertainty into learning – the role of cooperating teachers

In contrast to earlier findings claiming that directive mentoring styles prevail in mentoring dialogues (Edwards & Protheroe, 2004; Hennissen et al., 2008), this study found that cooperating teachers used both directive and non-directive moves in response to uncertainty. Giving information was the most frequent response, an interesting result in light of Hennissen et al.'s (2011) finding that student teachers perceive this kind of information transfer as offering both emotional support (when the given information matches with their ideas) and task-assistance (when the information opens a new perspective). Furthermore, few cooperating teachers offered direct advice to their student teachers - instead they formulated their responses as suggestions. This finding can be explained by the fact that some of the cooperating teachers had participated in training sessions on Content-Focused Coaching, which specifically recommends a co-constructive approach to mentoring (West & Staub, 2003). To better understand whether cooperating teachers consciously adapt their communication styles, future research could focus on cooperating teachers who mentor more than one student teacher in the teaching practicum

and examine their communicative styles in response to uncertainty (see Van Ginkel, Oolbekkink, Meijer, & Verloop, 2015).

Regarding the relation between cooperating teachers' responses and student teachers' instructional learning, the qualitative analyses suggest that accommodating the communication style to student teachers' level of teaching experience and knowledge in response to uncertainty is important to support learning. Specifically, it seems that more experienced student teachers might benefit most from someone in the role of a "collaborator" (Ambrosetti & Dekkers, 2010), who jointly reflects on the difficulties that the student teachers recognize, but also someone who gives assistance when the uncertainty revolves around specifics of the class (e.g., pupils' prior knowledge) that student teachers may be unfamiliar with. Having a "collaborator" who can provide support during uncertain moments is equally important for less experienced teachers, but what they may additionally require is "a critical friend" (Kwan & Lopez-Real, 2005), someone questioning their decisions and encouraging meaningful reflection for them to become more aware of what issues are relevant in lesson planning. Surprisingly, the cooperating teachers in this study tended to adopt a more directive communication style with student teachers who had more experience and who introduced the uncertainty themselves. This could be explained by the fact that the cooperating teachers might have felt that they were expected to know and to tell (Schuck & Buchanan, 2012), and if a student teacher repeatedly addressed an uncertainty, they might have thought that they were supposed to provide an answer to it. Therefore, informing cooperating teachers about the different needs of student teachers facing uncertainty and the different roles required to support inquiry and knowledge development could help them to better assist student teachers in these moments.

Taken together, the results support the notion that uncertainty is not a hindrance or something to be embarrassed of. Rather, it may open up learning opportunities that can be translated into positive learning outcomes with the support of cooperating teachers. As Dewey noted, a disciplined, inquiring mind "takes delight in the problematic" (1929, p. 228) and enjoys the doubtful. Obviously, we do not claim that all student teachers need to be uncertain in order to learn, but we do want to highlight that being aware of the uncertain character of teaching allows for beliefs and practices to be challenged and readapted in the course of the teaching activity.

8.4. Limitations

This study addressed an important issue in a realistic situation at three different institutions across the German-speaking part of Switzerland. Nevertheless, it is important to note that the sample consisted of highly motivated, probably rather confident participants that consented to be videotaped. Additionally, identifying uncertainty in student teachers' responses is sometimes very context-dependent and often relies on some degree of subjective interpretation of observers. From the uncertainty codes alone, it is not always possible to tell whether uncertainty expressions are being used to express subjective feelings of uncertainty or to do politeness work (see Brown & Levinson, 1978). Further research is needed to untangle student teachers' intentions behind uncertainty expressions and, potentially, whether student teachers' gender influences the realization of uncertainty. Finally, since this is a qualitative study in essence, it refrains from claiming causal relationships between cooperating teachers' responses and student teachers' instructional learning. Rather, its detail illustrates perspectives that could well be taken up by larger studies in different countries and educational contexts, for instance by also exploring student teachers' and cooperating teachers' perceptions and preferences for dealing with uncertainty.

8.5. Conclusion

This study explored student teachers' uncertainties and cooperating teachers' responses to them in the context of pre-lesson conferences. By adopting a linguistic approach, we were able to identify uncertainty in mentoring conversations using markers such as adverbs, nouns, or conjunctions of condition, as well as prosodic cues (longer pauses). The results suggest that student teachers' uncertainty in pre-lesson conferences provides potentially a learning opportunity because it allows the exploration of different instructional possibilities and student teachers can learn to better anticipate difficulties. Further research is needed to better understand cooperating teachers' responses to uncertainty and how conscious or subconscious they are, as well as the extent to which their communicative style matches student teachers' individual preferences in order for them to solve their uncertainties successfully.

Author note

This research was supported by a grant from the Swiss National Science Foundation [grant number 117891].

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