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## Fostering students' reflection: examining relations between elements of teachers' knowledge

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### ABSTRACT

This study investigates the knowledge that experienced teachers draw on when fostering students' reflections. Reflective skills are crucial for advancing students' learning. In order to promote students' reflection productively, extensive support and scaffolding from teachers is indispensable. However, teachers are in need of more guidance in this area. To inspire pedagogies for teacher training, this study provides insight into the knowledge that teachers employ when they are engaged with promoting their students to reflect. Video vignette interviews were administered to 36 teachers in secondary vocational education for nursing to elicit their knowledge. Interview transcripts were coded using categories for assessing teachers' curricular, pedagogical and instructional knowledge. To investigate relations between the elements of teachers' knowledge, we performed a lag-sequential analysis that enables statistical testing of observed sequences of categorised events. Four salient relations between elements of teacher knowledge emerged: (1) instructional knowledge as instrumental to construing pedagogical knowledge; (2) instructional knowledge contingent on pedagogical knowledge; (3) instructional knowledge and curricular knowledge related to fostering critical reflection; and (4) instructional knowledge and curricular knowledge related to fostering planning. Implications for teacher training are discussed.

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### KEYWORDS

Teacher; teacher knowledge; reflection; video vignettes; transition analysis; vocational students

### Introduction

This study investigates the knowledge that experienced teachers draw on when fostering students' reflection. Current models of self-regulated learning state that reflective skills are crucial for students to advance their learning strategies (Zimmerman 2000). Moreover, reflection is seen as an essential aspect of professional practice and as a catalyst for sustained professional learning and development (Gustafsson and Fagerberg 2004). It is also commonly acknowledged, however, that reflective thinking necessitates extensive assistance and scaffolding to make it functional (Boud, Cressy, and Dochtery 2006; Jay and Johnson 2002). However, little is known about how teachers understand and develop reflective skills in their students. Moreover, teachers need more guidance in this area (Asselin 2011; Mann, Gordon, and Macleod 2007). Knowing more about the structure of the knowledge that experienced

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teachers draw on when they are confronted with common situations and problems with respect to fostering reflection in students can contribute to inspire teacher training in reflective pedagogies.

This study investigates the knowledge that experienced teachers employ when reacting to situations that are common in the context of stimulating students' reflection skills. Below, we will firstly describe three requirements for assessing teachers' knowledge. Secondly, we will describe how we operationalised teachers' knowledge for fostering their student to reflect. Thirdly, we will describe our specific research aims.

### *Capturing teachers' knowledge*

Teacher knowledge is often referred to as 'teacher practical knowledge', and has been conceptualised as the integrative aggregate of beliefs, cognitions and knowledge teachers enact when they encounter particular situations or problems in teaching practice (Carter 1990; Meijer, Verloop, and Beijaard 1999; Verloop, Van Driel, and Meijer 2001). It is commonly acknowledged that teachers' knowledge strongly influences teachers' classroom practices (Cochran-Smith and Zeichner 2005; Evans and Kozhevnikova 2011). Teacher knowledge is known to have an iterative reciprocity with teachers' practice (Shulman 1986, 1987). This means that teacher knowledge not only affects a teachers' teaching practice, but that is also affected by experiences in his or her teaching (Donche and Van Petegem 2011; Van Driel and Berry 2010).

A great deal of research on teachers' knowledge is available and three important requirements are generally considered essential for eliciting and assessing teacher knowledge: (1) teacher knowledge is necessarily defined in and adapted to a particular content domain being taught (Grossman 1990; Shulman 1986), (2) methodological approaches for capturing and analysing teacher knowledge should cope with the challenge that knowledge is inherently embedded in teachers' ongoing actions (Beijaard and Verloop 1996; Meijer, Verloop, and Beijaard 2002), (3) taxonomies of teachers' knowledge should provide insight into the structure of teacher knowledge in terms of how different elements of teacher knowledge relate to each other (Henze, Van Driel, and Verloop 2007; Verloop, van Driel, and Meijer 2001). In the following, we elaborate on these three requirements.

Firstly, Putnam and Borko (2000) describe teachers' knowledge as a filter for accommodating new experiences and information or for making choices between alternative instructional activities. Consequently, it is necessarily defined in and adapted to a particular content domain being taught (Grossman 1990; Shulman 1986). Various authors have constructed taxonomies of teachers' knowledge on: teaching reading comprehension (Meijer, Verloop, and Beijaard 1999), science teaching (Loughran, Mulhall, and Berry 2004; Van Driel, Verloop, and De Vos 1998), learning and teaching models and modelling in science (Henze, Van Driel, and Verloop 2007), and integration of technology into teaching (Kramarski and Michalsky 2010; Mishra and Koehler 2006). These studies provide functional insights into teachers' knowledge with respect to particular subject domains and into ways of representing this knowledge. However, in many studies, the categories employed as well as the differences between the knowledge described remain rather generic, such as teachers' knowledge about learners and their characteristics, content knowledge, general pedagogical knowledge, the curriculum, educational ends and purposes.

Secondly, as teachers' knowledge is integral to their work and most learning takes place through continuous action and reflection on recurring authentic situations (Beijaard and Verloop 1996; Meijer, Verloop, and Beijaard 2002), this knowledge is mostly tacit and difficult to articulate (Schön 1983). As knowledge is inherently embedded in teachers' ongoing actions, this consideration calls for methodological approaches that can directly tap into the tacit knowledge teachers use during actual authentic teaching situations. Several researchers have tried to elicit teachers' knowledge in response to particular prompts gathered by different instruments, such as interviews, concept maps and stimulated recall (Meijer, Verloop, and Beijaard 2002). For instance, Meijer, Verloop, and Beijaard (1999), Henze, Van Driel, and Verloop (2007), and Gholami and Husu (2010) required teachers to respond to questions asking them to articulate their cognitions concerning instructional strategies, assessment formats, goals and objectives, and students' understanding. These studies provide important insights into the methodological complexities involved in eliciting teachers' knowledge. However, more direct assessments of teachers' knowledge as it is enacted during actual teaching processes are needed.

Thirdly, teachers' knowledge serves as a functional knowledge base that teachers can call upon to generate, interpret and evaluate their teaching practices. Taxonomies of teachers' knowledge should thus provide an understanding of how different elements of this knowledge, such as knowledge about learners and their characteristics, content knowledge, general pedagogical knowledge, the curriculum, educational ends and purposes, relate to each other. As a result, some studies (e.g. Henze, Van Driel, and Verloop 2007; Meijer, Verloop, and Beijaard 1999) have provided important insights into the structure of teachers' knowledge. However, theoretical assumptions with respect to the ways in which proposed structures relate to each other remain indistinct. For instance, the question of how teachers' knowledge pertaining to representations and teaching strategies is embedded in or related to knowledge of student learning and understanding or to epistemologies of learning goals has not yet been answered in current taxonomies.

In sum, requirements for eliciting and assessing teacher knowledge are: (1) categories for describing teacher knowledge should have a level of specificity that is consistent with the domain-specific nature of knowledge, (2) methodological approaches employed for eliciting teacher knowledge should enable the direct assessment of the tacit knowledge teachers use during actual teaching and (3) there is a need for taxonomies of teachers' knowledge that provide detailed insight into the structure of teacher knowledge in terms of how different elements in a teacher's knowledge base relate to one another.

In the present study we aimed to cope with these requirements as follows. Firstly, we focused on examining and operationalising teacher knowledge in a particular content domain (i.e. fostering nursing students' reflection). Secondly, we employed video vignettes, which have the potential to directly elicit and capture teacher knowledge as it is enacted in authentic teaching situations in the context of a particular instructional setting (Kaiser et al. 2015; Kersting 2008; König 2015). Thirdly, we investigated relations between elements comprising teachers' knowledge. In the following section, we elaborate on how we operationalised teachers' knowledge for fostering their student to reflect. Next, we present the specific aims and content domain of the current study. In the method section, we provide more details on the video vignettes that we employed in the methodology we applied for exploring relations between elements within the teachers' knowledge structure.

### **Operationalising teachers' knowledge for fostering reflection**

We adopted the classification system proposed by Kreber and Cranton (1997, 2000), who describe teachers' knowledge systems as consisting of the following structural elements: *curricular knowledge* (e.g. 'for what goals do I teach this way?'); *pedagogical knowledge* (e.g. 'knowing my students and how they learn', 'how can I foster learning in these students?'); and *instructional knowledge* (e.g. knowing about teaching methods and strategies, 'what actions can I take in teaching?'). To explore configurations of teachers' knowledge that are specific to stimulating students' reflection, we applied Kreber and Cranton's knowledge system to what is known about reflection. Table 1 summarises the categories in our conceptualisation of teachers' knowledge for fostering reflection.

The idea of *curricular knowledge* corresponds to Schoenfeld's (1998) notion of a teacher's action plan, which involves a representation of how the teacher proposes to achieve a specific goal. Action plans might be seen as a means towards achieving this end, and might be guided by the rationales underlying a teacher's action. The ultimate goal of reflection is to improve current practices and develop the capacity to direct one's own development (Schön 1983). Based on the work of Habermas (1971), Van Manen (1977) and Schön (1983), Hatton and Smith (1995) distinguish three types of reflection: technical rationality, reflection-on-action and reflection-in-action. Technical rationality involves the description and examination of immediate behaviours or skills. Reflection-on-action has three distinct forms: descriptive, dialogic and critical. Descriptive reflection provides rationales for the actions undertaken. Dialogic reflection investigates alternative perspectives, claims and pathways towards a solution. Critical reflection locates any analysis of an action within wider socio-historical, political-moral and cultural contexts. Finally, reflection-in-action means the capacity to apply each of these reflection types to situations as they are actually occurring.

**Table 1.** Categories in the conceptualisation of teachers' knowledge for fostering students' reflection.

Category/subcategory	Description
Curricular knowledge	Comprises knowledge of the goal of stimulating students' reflection
<i>Pragmatic</i>	The goal is that students become more aware of what they are actually doing
<i>Understanding</i>	The goal is that students comprehend the knowledge, skills and attitudes that underlie their behaviour and that they realise why there are certain guidelines and norms
<i>Critical</i>	The goal is that students critically reflect on their own behaviour, knowledge and attitudes and that they make deliberate choices based on their judgments
<i>Judgement</i>	The goal is that students relate concrete experiences to guidelines, knowledge and protocols and develop their own knowledge as a result of experiential learning
Pedagogical knowledge	Knowledge enabling teachers to diagnose student characteristics and characteristics of student learning and adapt their teaching accordingly
Instructional knowledge	Knowledge of methods and strategies for stimulating students' reflection
<i>Description</i>	Asking for a factual description
<i>Plan</i>	Having students formulate a plan for action
<i>Analysis-critical</i>	Stimulating students to critically question and judge their behaviour, knowledge and attitudes
<i>Analysis-description</i>	Stimulating students to think about, justify and explain what they can learn from an experience and what this means for the future
<i>Analysis-perspective taking</i>	Stimulating students to perceive their behaviour from multiple perspectives or confronting students with other stances

Hatton and Smith (1995) reported a developmental sequence starting as a beginner with a relatively simplistic or partial technical reflection type, working through different forms of reflection-on-action to the desired end-point of a professional able to undertake reflection-in-action. According to these authors, an ideal end-point for fostering reflective approaches is the capacity to undertake reflection-in-action. More recently, Procee (2006) proposed a comprehensible positioning of the term 'reflection' based on Kantian epistemology that relates to Hatton and Smith's distinctions but adds to it. Procee distinguishes between *pragmatic* and *critical* substantiation: the former involves awareness of a particular experience or knowledge, the latter concerns critical deliberation on events, knowledge, and opinions. Both may be from single or multiple perspectives. Procee adds to the Hatton and Smith taxonomy by explicitly distinguishing reflection goals that are related to Dewey's (1968) final purposes of reflection: logically grasping formal knowledge and rules for practice by determinative judgement (*understanding*) and the capacity to generate knowledge and/or the ability to connect knowledge to actual practice by reflective judgement (*judgement*). Whereas 'understanding' reflects learning of formal knowledge based on authentic experiences, 'judgment' concerns the discovery of formal knowledge based on experiences. Being confronted with particular situations inviting them to reflect based on their knowledge, teachers might focus on these different goals when fostering reflection in students.

Being responsive to a particular student's level requires *pedagogical knowledge*, where instructional strategies are based on teachers' diagnoses of the reflection skills of that student (e.g. Pratt and Savoy-Levine 1998; Van de Pol, Volman, and Beishuizen 2011; Wood 1986). This operationalisation of pedagogical knowledge encompasses *diagnostic knowledge* (cf. Weinert, Schrader, and Helmke 1990), which enables teachers to implement instructional strategies that are adapted to the level and learning needs of the students, so they know when and how to effectively stimulate reflection (Weinert, Schrader, and Helmke 1990).

Finally, fostering the active and deliberate process of reflection in students involves engaging the students in cognitive activities. The literature indicates that thinking activities such as critical analysis, synthesis and evaluation are vital skills for reflection (e.g. Boud, Cressy, and Dochtery 2006). Teachers' *instructional knowledge* might be manifest in articulated concrete strategies for fostering these activities, focused on different cognitive activities that teachers encourage the students to engage in, such as: description, analysis and planning (cf. Oosterbaan et al. 2010). Instructional strategies aimed at fostering analysis involve stimulating students' reflection-on-action (Schön 1983), focusing on representations of *descriptive*, *dialogic* and *critical* reflection activities.

## The current study

In this study, we contribute to the knowledge base that may provide a basis for assisting teachers in fostering their students' reflection. For this purpose, we investigated the knowledge that teachers draw on when fostering reflection in their students. In specific, we explored the extent to which teachers employ curricular, pedagogical and instructional knowledge when reacting to common situations in the context of stimulating vocational students' reflection. In addition, we aimed to gain insight in the structure of teachers' knowledge by exploring how teachers' curricular, pedagogical and instructional knowledge are related.

As a content domain of our study, we focused on the sector of vocational nursing education, since developing students' reflective skills and assisting teachers in guiding their own student to develop these skills is commonly considered to be of crucial importance (Mann, Gordon, and MacLeod 2007). In line with the more general literature on reflection, fostering nursing students to reflect means that students are supported by teachers in a conscious, dynamic process of thinking about, analysing and learning from a clinical experience, enabling the nursing student to gain insight into self and professional behaviour (Thompson and Burns 2008). Similar to what has been written about reflection in other fields of professional practice, reflection is seen as a way for nurses to investigate the depth and complexity of their professional practice, see the meaning of why they do what they do, grasp the creativity of practice, explore the emotional aspects of a situation, and attain a rich understanding of nurse–patient interactions. The reflective insights gained, should assist nurses to respond to clinical situations with a changed perspective. However, it is commonly acknowledged that reflection on professional practice can be difficult and that guidance and feedback are essential for developing reflective skills (Asselin 2011; Oosterbaan et al. 2010). Furthermore, teachers are in need of furthering their knowledge with regard to stimulating their students to reflect (Asselin 2011; Mann, Gordon, and MacLeod 2007).

The current study addresses the following research questions:

*Research question 1: Which elements of teachers' knowledge are activated when promoting vocational students' reflection?*

*Research question 2: Which relations between different elements of knowledge are characteristic for the structure of the teachers' knowledge base pertaining to stimulating vocational students' reflection?*

## Method

### Context of the research

Our research focuses on experienced teachers who teach and supervise students in vocational education for becoming licensed as second level nurses in the Netherlands (level IV of the International Standard Classification of Education, UNESCO). Their students are prepared, through the study of nursing theory and clinical practice, to provide care in co-operation with and under the supervision of a first-level nurse. Usually, during vocational nursing education, in line with the international literature that has stressed the need to design curricula in vocational education in terms of pathways of participation in social practice (Billett 2001; Tynjälä 2008), students spend periods of time on internships, during which learning from experiences is important.

As in many health profession education programmes in other countries (Dekker-Groen, Van der Schaaf, and Stokking 2011; Mann, Gordon, and MacLeod 2007), reflective skills are considered vital to students' development in Dutch senior secondary vocational nursing education as well. Since nursing students are educated to become professionals in caring, it is seen as essential for them to be able to guide, evaluate and adapt their professional behaviour based on a process of reflection. Teachers are involved in fostering their students to reflect on their thoughts, actions, feelings, and attitudes during situations within the context of their knowledge, experience, beliefs and assumptions. Eventually aiming to assist student nurses to respond to clinical situations with a changed perspective and to enable them to keep on learning as a professional (Asselin 2011).

## Sample

Thirty-six teachers in secondary vocational education for nursing participated voluntarily. The teachers came from nine different schools. Nine of them were male. Their average age was 48 (SD: 6.5) and their average teaching experience was 12 years (SD: 7.9), with no significant differences between schools on these measures. The sample is representative of the wider group of educators in Dutch vocational education, where a large majority of teachers is female, and, teachers are usually aged older than 35 (see <http://www.onderwijsincijfers.nl/kengetallen/mbo/personeelmbo>). In short, a typical participant in our study can be characterised as an experienced educator, qualified as a registered nurse and licenced as a teacher in nursing. Although they had different teaching duties within their school, such as teaching different subjects (e.g. anatomy, arithmetic), mentoring groups of nursing students, coordinating work placements, all of them were also involved in fostering students to reflect.

## Instrument: video vignette interviews to capture teachers' knowledge

To assess vocational nursing teachers' curricular, pedagogical and instructional knowledge, we employed video vignette interviews. Vignettes were designed to provide teachers with multiple authentic situations that are prototypical in their teaching context and which are depicted in video captions. Interview protocols were used to elicit teaching interventions and teachers' rationales and thoughts behind these interventions in the depicted situations. Video vignettes are considered a favourable method to capture the knowledge that teachers employ, since multiple distinctive situations can be covered in them (Kaiser et al. 2015; Kersting 2008; Köning 2015). Moreover, direct and comparable assessments of teachers' knowledge can be realised, since the interview protocol requires each teacher to respond individually to each of the vignettes (cf. Kaiser et al. 2015).

In developing the vignettes we focused on producing a set of hypothetical teaching situations that are prototypical and critical to the teaching of reflection skills in the context of nursing at secondary vocational level. The vignettes were developed in three main steps (Chen and Matthews 2003; Rosengren et al. 2005). Firstly, scripts for the vignettes were developed iteratively based on: (a) a review of the literature on nursing students' reflection (Hough 2008; McBrien 2007; Wolf and Zuzelo 2006); and (b) interviews with practitioners in the field. Examples of prototypical topics in students' reflections as derived from our literature review are: experiencing gaps between theory and practice, experiencing communication problems with patients and family, suffering from feelings of failure to act correctly in their professional practice as a nurse, coping with work pressure and coping with hospitality in the work environment. Examples of commonly occurring problems with regard to fostering nursing students' reflections are: students do not critically consider their own learning processes and functioning with regard to becoming a professional nurse, or fail to engage in conscious and dynamic processes of thinking about, analysing, and learning from clinical experiences. The scripts for our vignettes were based on commonly occurring problems and prototypical topics with regard to students' reflections so as to cover multiple authentic situations in the particular teaching context at hand.

Each vignette consists of context information describing a particular critical situation and four typical student utterances. The scripts were subsequently discussed in a meeting with three experts: one from the field of reflection, one from the field of teacher competence measurement and one with expertise in both areas. Based on their comments, the prompting questions were optimised and structured for the vignette interview (i.e. 'How would you react to this situation?'; 'Why?'; 'What do you intend to promote in terms of student learning with these interventions?'; and 'How would you handle this situation?'). These questions were asked after each student utterance. Secondly, videos were recorded and produced with seven students from the field of nursing based on these scripts. Eight video vignettes were produced. Thirdly, the video vignettes were discussed in a meeting with a group of research experts on teaching. In addition, the vignettes were piloted with two teachers from the field of nursing and two teachers with expertise in stimulating reflection in teacher education. This

resulted in optimised context information for the vignettes, (i.e. more information on the background of the student), and omitting two vignettes. In Table 2, we provide an overview of the six vignettes that were used in this study according to their prototypical and critical content (in Appendix 1, we provide a complete overview of the video vignettes).

**Table 2.** Overview of the vignettes according to their prototypical and critical content.

Context description vignette	Prototypical and critical situation
Aliya has been given an extension to her internship because she does not stick to agreements made and she does not behave professionally with patients. Aliya, however, does not see any problem and is not amenable to feedback; she does not consider her role critically or take responsibility for her own development. Aliya is a first year student whose professional behaviour is frequently disappointing	Student does not critically consider her own learning processes and functioning with regard to becoming a professional nurse Communication problems with patients
Returning from one of her first internships, Susan says that she's noticed that many staff do not follow the hygiene measures that are taught at school. Most people, for instance, work with watches on their wrists and with long polished nails, while at school she was taught that this is unhygienic. Susan gets confused and is indignant. Susan is a first year student who normally obtains good results	Experiencing gaps between theory and practice Student fails to engage in conscious and dynamic processes of thinking about, analysing, and learning from clinical experiences
During a group lesson to practise communication skills, students participate in a role-play in which they have to practise providing an explanation. One student, Yashmin, has to explain to a family that a patient will be transferred to a different ward at a different location. Yashmin does not speak to the family politely and she does not show empathy. Yashmin does not see the value of the exercise and does not have a clear view of what is expected from her as a nurse in communicating with patients and their families. Yashmin is a second year student whose professional conduct is often below standard	Communication problems with patients and family Student does not critically consider her own learning processes and functioning with regard to becoming a professional nurse
Returning from her internship, Diana talks about a situation in which she was uncertain how to act. She talks about a patient who suffered a great deal of pain during wound care, which caused him to be angry and irritated with her. Against instructions, Diana decided not to dress the patient's wound the following day, but leave the adhesive bandage one more day. She did not inform her senior colleague about the patient's pain or ask her colleague for help. Diana is a second year student with average performance	Suffering from feelings of failure to act correctly in their professional practice as a nurse Coping with work pressure
During a conversation about her internship, Dominique indicates that she has no time to complete her school assignments. She works long hours at her internship and she has also been scheduled for the weekend shifts. Dominique says she doesn't know when she is supposed to work on all her school assignments. She has protested a little to the person who draws up the roster, but she didn't dare to say too much about it. Dominique doesn't know what to do next. Dominique is at the end of her first year, is very motivated and performs well	Coping with work pressure Student does not critically consider her own learning processes and functioning with regard to becoming a professional nurse
During a conversation about her internship, Amber talks about a situation she encountered. At Amber's internship, the team discusses the most appropriate treatment for patients. During one of those meetings, where Amber is present, her colleagues propose a certain treatment for a patient. Amber thought this was not the best treatment. She had learned about an alternative treatment at school that seemed much more appropriate in this situation. She tried to express her opinion but no one listened to her. Amber is a third-year student who performs well	Coping with hospitality in the work environment Becoming a professional nurse

## Procedure

The procedure of the vignette interview was explained to the teachers. They were asked to explain clearly and in detail how and why they would react to each critical situation depicted, what their rationales for these interventions were and what their next instructional strategies would be. The same interview protocol was used in all 36 interviews. Each teacher individually responded to each of the vignettes and each interview took about one hour. Participants were informed that the aim of our study was to gain insight into their knowledge and thought processes pertaining to commonly occurring situations and problems with regard to fostering reflection in students. They were reassured that their responses were not being evaluated in connection with student reflective ability and that their information would be kept confidential and that participation was anonymous.

## Analysis

Voice recordings of teachers' responses to the vignettes were transcribed to obtain verbal protocols. To gain insight in the curricular, pedagogical and instructional knowledge that teachers draw on (first research question), we developed a coding scheme for analysing the verbal protocols using categories obtained from our synthesis of the literature (see Table 1). Then the criteria and descriptions of these codes were modified in several analysis rounds based on a detailed study of the protocols.

For *curricular knowledge* we coded the teachers' arguments in terms of goals for student reflection: pragmatic, critical, understanding or judgement. *Pedagogical knowledge* was coded as either diagnosis or differential diagnosis. The latter was a code that emerged from our analysis, referring to a diagnosis in which a teacher aimed to test multiple hypotheses without a preliminary conviction. *Instructional knowledge* was derived by coding the articulated teaching interventions in terms of thinking activities that teachers seemed to stimulate in students. We distinguished: description, analysis and planning. In codes related to the analysis phase, we further discriminated between different forms of giving meaning to reflective analysis: (1) analysis to account for situations and/or explaining situations and drawing conclusions for future situations; (2) critical analysis; and (3) analysis from multiple perspectives. In addition, we added two new codes to the *Instructional knowledge* category. Firstly, teacher interventions where the teacher was providing information to foster reflections were coded as 'transmission'. Secondly, interventions focused on constructing a supportive environment for the students were coded as 'creating a safe environment'. Appendix 2 presents our analytic scheme for teachers' knowledge for fostering students' reflection, accompanied by example quotations. Verbal protocols were segmented into meaningful units composed of coherent continuous talk on a single topic or theme (cf. Chi 1997). Segments of teacher utterances were coded by assigning a code for curricular, pedagogical or instructional knowledge (see Table 1). Interrater reliability for these codes was determined by comparing the ratings of two independent judges ( $n = 489$ ; Cohen's kappa = .75).

Subsequently, to investigate how the different elements of teachers' knowledge were related (second research question), we explored how often each categorised element of articulated knowledge followed another employing lag-sequential analysis. This analysis technique treats each coded segment as an observation and detects the various non-random aspects of sequences to reveal how certain types of teachers' knowledge follow others more often than what one would expect by chance (Erkens 2005; Wampold and Margolin 1982). It accomplishes this by comparing the expected and actual transition probabilities between coded segments signifying teachers' curricular, pedagogical or instructional knowledge to identify statistically significant transitions from one knowledge type to another. These transition probabilities can then be converted into likelihood ratios to be used for statistical testing (Kapur 2011). The lag-sequential analyses technique has also been applied in studies investigating sequences of teacher learning activities (Zwart et al. 2008) and in computer-supported collaborative learning research wherein transition patterns between process categories are examined (e.g. Kapur 2011).

An example to illustrate the relevance and use of our lag-sequential analysis is provided below. The lag-sequential analysis showed, for instance, that segments where teachers intended to confront students with inconsistencies in their reasoning (analysis-perspective taking) were followed significantly more often by segments where they asked students to critically reflect on their behaviour (analysis-critical). An example of a coded excerpt illustrating this relationship is the following excerpt, which is taken from the second prompt of the fourth vignette. In this segment,<sup>1</sup> teacher 26 responds to a student who decided not to dress a patient's wound according to patient care protocols and did not inform her senior colleague about this incidence.

So I would, I think, confront her in that way: first you say that you are unable to do it, then that no help is available and then you decide to do it yourself	Analysis-perspective
Well, er, yes and plus whether she is aware of the consequences. She does something and does she know the consequences if it goes wrong...	Taking <sup>k</sup> Analysis-critical <sup>k</sup>
Excerpt teacher 26; vignette 4	

This excerpt illustrates a close relation between two elements in teachers' instructional knowledge base that appeared to be activated in close proximity: knowledge about methods and strategies to stimulate perspective-taking and critical reflection. This transition means that when teachers intend to stimulate their students to critically question and judge their own way of talking, thinking and behaving, they frequently confront them with other perspectives.

The software programme Multiple Episode Protocol Analysis (MEPA) was used for carrying out the lag-sequential analysis for the purpose of exploring how often each categorised element of articulated knowledge followed another. MEPA is a programme developed for the flexible annotation, coding and protocol transcription of dynamic verbal or non-verbal observational data (Erkens 2005). For our lag-sequential analysis, the sequences of segments that were coded as articulations of curricular, pedagogical or instructional knowledge are summarised within a transition matrix that shows how often one coded segment precedes another. Whether or not the actual transitional frequencies differ from those for the equiprobable (zero-order) model in which the probabilities of one coded segment following another are equally divided across all the coded segments is then tested. A significant transition occurs when the number of observed transitions between two coded segments is significantly higher than expected based on the distribution of coding (test of uni-directional transitions using *z*-scores, taking into account the conditional probabilities for every transition) (Wampold and Margolin 1982). In this way information is being gathered on how certain types of teachers' knowledge follow others more often than what one would expect by chance (Erkens 2005; Wampold and Margolin 1982).

Below, when presenting our results, we will further illustrate how this analysis enabled us to explore the relations between the curricular, pedagogical and instructional knowledge teachers employ when promoting students' reflection.

## Results

*Research question 1: Which elements of teachers' knowledge are activated when promoting vocational students' reflection?*

In order to provide a general overview of the curricular, pedagogical and instructional knowledge teachers draw on when reacting to the prototypical and critical situations, we first present the mean percentages of codes assigned to segments in the teachers' verbal protocols (see Table 3).

Teachers frequently expressed intentions to construe diagnoses of students' needs. The number of segments in which teachers transmitted information was also high. With respect to epistemological arguments for fostering students' reflective skills, teachers mostly articulated intentions to attain pragmatic goals. By contrast, segments where teachers expressed the need to foster students' reflective understanding or judgement were relatively rare.

*Research question 2: Which relations between different elements of knowledge are characteristic for the structure of the teachers' knowledge base pertaining to stimulating vocational students' reflection?*

**Table 3.** Mean percentages of assigned knowledge and object codes.

	Total
Curricular knowledge	
Pragmatic	12.07
Understanding	0.58
Critical	2.85
Judgement	0.09
Pedagogical knowledge	
Diagnosis	26.22
Differential diagnosis	8.06
Instructional knowledge	
Description	10.75
Transmission	21.53
Plan	3.68
Analysis-critical	2.08
Analysis-description	4.41
Analysis-perspective taking	3.48
Creating a safe environment	4.46

As outlined above, a transition analysis was performed to investigate the extent to which particular sequences of codes might indicate relationships between teachers' curricular knowledge, pedagogical knowledge and instructional knowledge. This analysis determined whether particular transitions of coded segments occurred significantly more often than would have been expected based on chance. The diagrams that MEPA produces only show the significant transitions, with the width of the arrows indicating the level of significance. A large number of different transitions in the diagrams points towards an unstructured protocol: the fewer arrows, the more structured the protocol. To prevent infrequent codes nevertheless leading to significant transitions, only those transitions with an expected frequency of 5 or higher were included in the analysis. Figure 1 shows an overview of the significant aggregated transitions occurring in teachers' protocols. The line thickness indicates the magnitude of the difference between observed frequency and expected frequency.

What is apparent in Figure 1 is that some segments where teachers articulate curricular knowledge (i.e. pragmatic and critical), pedagogical (i.e. differential diagnosis) or instructional knowledge (i.e. planning, creating safe environment, transmission, description, analysis-description, analysis-perspective taking) are persistent, in that they tend to extend across multiple segments. Below, we describe and illustrate specific details on of the significant transitions found between teachers' curricular, pedagogical and instructional knowledge.

### **Curricular knowledge and pedagogical knowledge**

This relation involves the significant transition found between coded segments where teachers articulate the goal of fostering a pragmatic level of reflection (curricular knowledge) and the articulation of a diagnosis of a student (pedagogical knowledge) (see Figure 2). More concretely, this transition means that when teachers want their students to become more aware of what they are actually doing (curricular knowledge), they substantiate this goal by articulating a diagnosis pertaining to the potential needs and characteristics of the student and her learning to adapt their teaching accordingly.

An example of a coded excerpt illustrating this relationship is provided below. The segment shows teacher 13's reaction to the first prompt of vignette 1 (see Table 2 – and Appendix 1 for a full overview – for the vignettes). This vignette involves a student who is not aware of her not behaving professionally with patients. When the student states 'everything is going just fine, I enjoy the work I am doing' teacher 13 responds as follows:

To have her become conscious: Gosh, I am not doing those things. That is my underlying goal, so she will say this herself instead of me saying she is not doing well. Yes	Pragmatic <sup>CK</sup>
Ehh, well, I think, that is difficult in this situation, but I think because she indicates that she is not conscious of her own functioning, or that she is not critically reflecting on herself	Diagnosis <sup>PK</sup>

Excerpt teacher 13; vignette 1

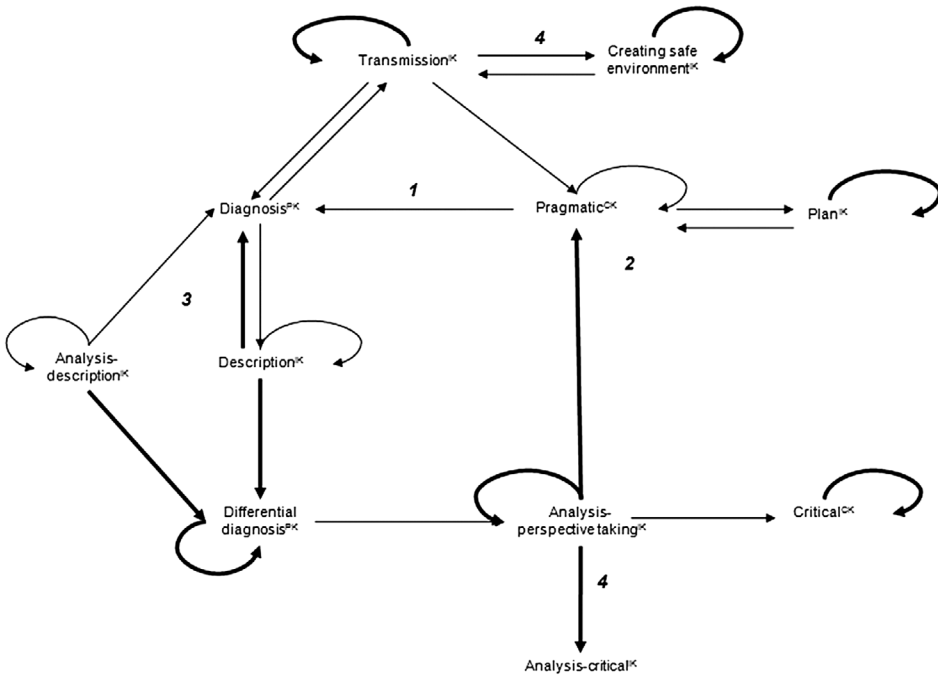


Figure 1. Significant transitions between codes reflecting teachers' curricular knowledge (CK), pedagogical knowledge (PK) and instructional knowledge (IK).



Figure 2. Transition diagram displaying the relation between curricular knowledge and pedagogical knowledge.

This argument shows a relation between teacher 13's curricular knowledge and pedagogical knowledge in that she articulates an argument for achieving a particular pragmatic goal for stimulating student's reflection (curricular knowledge), which is based on a diagnosis of the student's characteristics (pedagogical knowledge). More concretely, teacher 13 states that her goal is to have the student become conscious of her not behaving professionally with patients instead of her informing the student about this (curricular knowledge-pragmatic), because she contends that the student is not 'critically reflecting on herself' (pedagogical knowledge-diagnosis). In terms of the structure and functioning of the teachers' knowledge, this excerpt illustrates that pedagogical knowledge typically framed and provided the rationales for curricular knowledge involving pragmatic goals.

**Curricular knowledge and instructional knowledge**

This relation involves significant transitions between codes for: analysis-perspective taking (instructional knowledge) and pragmatic (curricular knowledge), analysis-perspective taking and critical (curricular knowledge), pragmatic and plan (instructional knowledge) and transmission (instructional knowledge) and pragmatic (see Figure 3). Firstly, this means that articulating interventions aimed at confronting students with other perspectives (instructional knowledge) are frequently followed by arguments focusing on stimulating pragmatic reflection goals (where the goal is that students become more aware of what they are actually doing) or students' critical thinking (curricular knowledge).

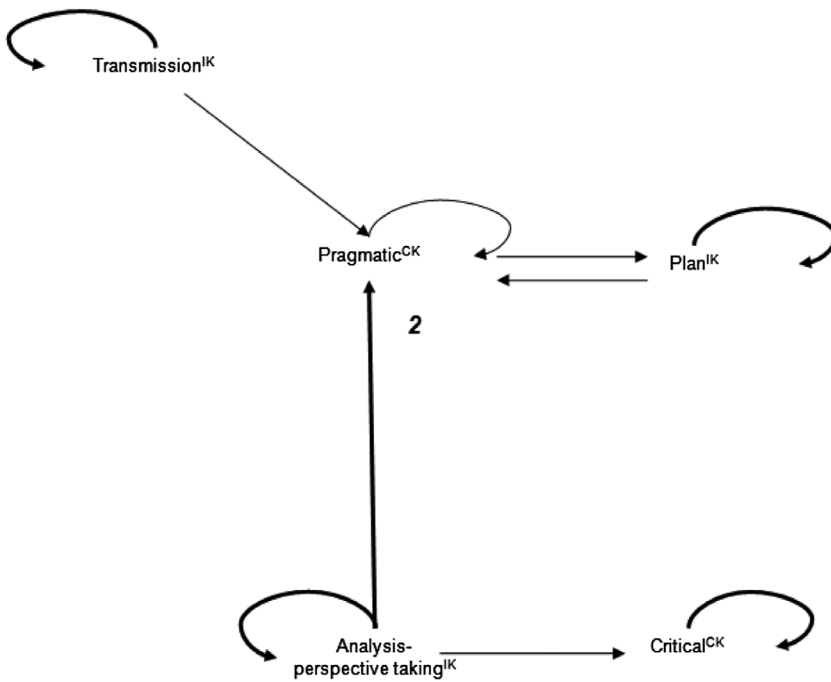


Figure 3. Transition diagram displaying the relation between curricular knowledge and instructional knowledge.

Secondly, teachers articulating the goal of fostering a pragmatic level of reflection (curricular knowledge) is often preceded by segments where teachers transmit knowledge or where they ask students to plan (instructional knowledge). We will provide some examples of the relations found between instances of curricular knowledge and of instructional knowledge below.

The following excerpts will illustrate the significant transitions found between (1) analysis-perspective taking (instructional knowledge) and critical (curricular knowledge) and (2) plan (instructional knowledge) and pragmatic (curricular knowledge).

Firstly, in the following transcript, teacher 31 responds to the fourth prompt in the third vignette. In this vignette the student shows a lack of empathy in communication with the patient and family in a role-play. In the fourth prompt the student asks the teacher how she can behave more empathetically.

Yes, so I would involve the others, so then it would be something for all of them and not just Yashmin and me. Then the other students would also play a role	Analysis-perspective taking <sup>IK</sup>
That she is critical of her own behaviour, that she is more open to things	Critical <sup>CK</sup>

Excerpt teacher 31; vignette 3

In this excerpt, we clearly see an instance of a particular pattern where teachers attempted to achieve goals explicated in their curricular knowledge through activating a particular aspect in their instructional knowledge base. More specifically, in this instance, teacher 31 expressed the intention to foster the student’s critical reflection on her way of communicating with patients by confronting her with other perspectives. The teacher would involve the other students (instructional knowledge-analysis-perspective taking) in order to foster more critical reflection in the student with regard to her behaviour in communicating with patients (curricular knowledge-critical). More concrete, this relation indicates that instructional knowledge about methods and strategies for stimulating students to consider conflicting perspectives is connected to teachers’ curricular knowledge related to stimulating students’ critical reflection.

Secondly, the following two excerpts were taken from teacher 35’s and teacher 30’s reactions to the first prompt of vignette 5 and the second prompt of vignette 1, respectively. In the first excerpt,

teacher 35 responds to a situation in which the student articulates that she experiences work pressure at her internship and is unable to spend sufficient time on school work. The second excerpt involves the reaction of teacher 30 to the student expressing discontent regarding the communication with her supervisor, who allegedly is not available when the student needs her help.

And I would go into that, look at how she feels if she tries that and how she can change that. How can you create a situation in which you get to talk to your supervisor? How can you get to discuss your point? So she, yes, learns to manage that situation better and to be more assertive Excerpt teacher 35; vignette 5	Plan <sup>IK</sup>  Pragmatic <sup>CK</sup>
Yes, what I just said, that it is also in part her responsibility, it is her learning process, she has to take it further and, er, I want to coach her in that, but she is partly responsible for her own learning process So, er, that's why I throw the ball back in her court, er, how are you going to deal with it yourself, what have you done about it yourself? Excerpt teacher 30; vignette 1	Pragmatic <sup>CK</sup>  Plan <sup>IK</sup>

This relation indicates that articulating knowledge about interventions for stimulating students' planning (instructional knowledge) was related to instrumental rationales activated from teachers' curricular knowledge base as reflected in significant transitions between the coded segments. In the examples above, the teachers express the intention to ask the student what she could do in similar situations with regard to work pressure during internship and communication with supervisors (instructional knowledge-plan) so as to enable the student to manage such situations better in the future (curricular knowledge-pragmatic). This relationship signifies that when teachers draw on this particular instance of instructional knowledge (plan), this typically originates from the teachers' goal of students to become more aware of what they are actually doing (curricular knowledge-pragmatic).

The final excerpt exemplifies the significant transition found between transmission (instructional knowledge) and pragmatic (curricular knowledge). In this fragment, teacher 6 responds to the fourth prompt in the second vignette. This vignette focuses on a student who notices that many staff at her internship do not follow the hygiene measures that are taught at school, since some of them seem to work with long polished nails. In her indignation with respect to this incongruence between theory and practice, she states 'What can be wrong with long nails? I wash my hands 5 times a day'. Teacher 6 responds as follows:

And, eh, well about hygiene, safeness and you could talk about infections and all those things and, eh, well yes, that whole story, eh, sort of, so I would have a short instructional dialogue with this student, yes Well, that she, that she knows how it is and how, she has to repeat it then and she has to see the usefulness of it then, eh, she just has to learn it again, repeat it, yes, yes Excerpt teacher 6; vignette 2	Transmission <sup>IK</sup>  Pragmatic <sup>CK</sup>
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In this excerpt, teacher 6 expresses that the student needs an instructional dialogue (instructional knowledge-transmission), because according to teacher 6 the students need to relearn by repeating the theory on hygiene measures (curricular knowledge-pragmatic). Thus, pointing to a transition between an aspect of teachers' instructional knowledge base that was followed by curricular knowledge. In sum, in terms of the structure and functioning of the teachers' knowledge, the examples above show that curricular knowledge involving either critical or pragmatic goals typically framed and provided rationales for their instructional knowledge.

### **Pedagogical knowledge and instructional knowledge**

This relation involves the significant transitions found between diagnosis and differential diagnosis (pedagogical knowledge) on the one hand and description and analysis-description (instructional knowledge) on the other (see Figure 4). This set of relations entails that teachers' expressed need for students' descriptions is significantly more often followed by segments where they articulated the intention to construe a diagnosis or differential diagnosis of this student. This indicates a relation in teachers' knowledge that shows how teachers aimed to construct a representation of the possible needs of students (pedagogical knowledge) based on descriptions provided by their students in response

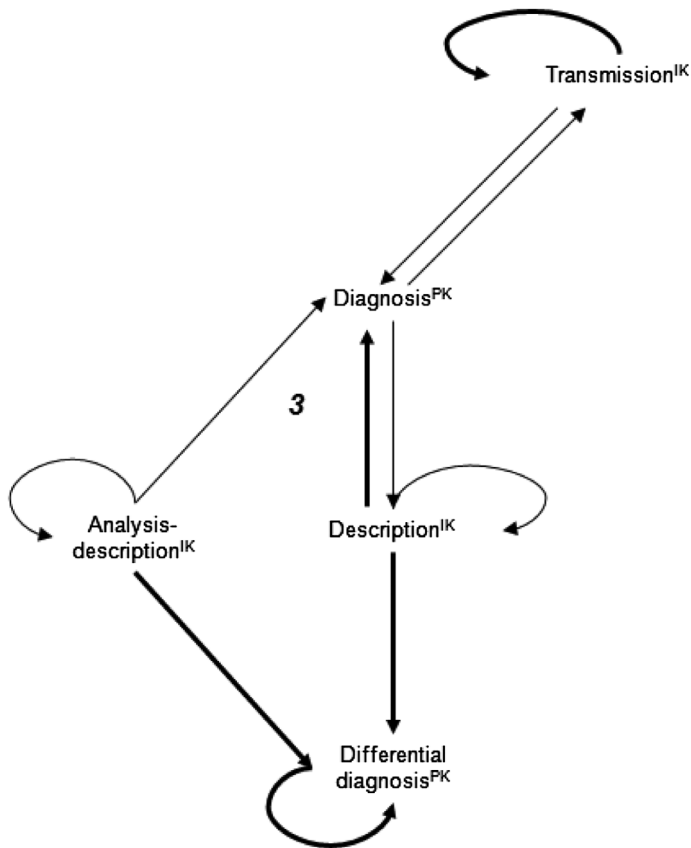


Figure 4. Transition diagram displaying the relation between pedagogical knowledge and instructional knowledge.

to teachers’ intentions to ask their students for a factual description (instructional knowledge). In addition, significant transitions were found between diagnosis and transmission (instructional knowledge). More concrete, this indicates that teachers’ intentions to transmit knowledge were based on or argued from their diagnosis of the student. Some examples of coded excerpts exemplifying both relations are provided below.

Firstly, the segment below involves teacher 24’s first response to the third prompt of vignette 6. In this vignette the student expresses her discontent about her colleagues rejecting the alternative treatment she had proposed during a meeting. When the student articulates that she has a ‘wearisome feeling working on this ward’, teacher 24 responds as follows:

Well, you think that we discussed it too little, what would you still like us to discuss, what is bothering you?	Description <sup>IK</sup>
Coming back to that, ask yourself what feeling, or, er, where do you need support?	
You need up-to-date things, er, this is something that has already been discussed, so it is important. If you don’t do that then, yes, next time she will be disappointed at school so then it will be a double disappointment	Diagnosis <sup>PK</sup>
Excerpt teacher 24; vignette 6	

In this excerpt we see that teacher 24 first activates her instructional knowledge base that is based on an assumption originating from her pedagogical knowledge base. More specifically, framed by a particular assumption or diagnosis regarding the possibility of the student’s disappointment expanding to schoolwork (see third line), the teacher formulates questions prompting the student to describe her feelings and needs (instructional knowledge-description) first, in order to gain information on what is

actually bothering her about the depicted situation in the vignette (pedagogical knowledge-diagnosis) and where she feels she needs support (see first line).

The following excerpt was obtained from the transcript of teacher 4 in response to the first prompt of vignette 4. Teacher 4 responds to a student who failed to provide appropriate patient care, stating she was unable to request help from a colleague.

At the same time, I think: Well maybe I would first like to know, er, what effect that had on her. Before I can ask her, yes, first I want to know, okay, what did that mean to you at that moment? Yes that would be my first question	Analysis-description <sup>IK</sup>
Er, because I, er, would like to find out what it is that moves her not to inform her colleague and, er, to do this in this fashion. I would like to know, er, what her reasoning is and if she uses knowledge that is needed in that case, whether there are other matters that play a role	Differential diagnosis <sup>PK</sup>
Excerpt teacher 4; vignette 4	

This excerpt shows that teacher 4 intended to explore the student's rationale and the thoughts underlying her actions (see the second line), by asking the student for an elaborate explanation what effects the event had on her (see the first line). This involves articulations originating from teacher 4's instructional knowledge base framed by intentions to provide input to her pedagogical knowledge base.

More concrete, this relation involves a connection between teachers' pedagogical and instructional knowledge bases in generating interventions for fostering students' reflection. Based on an in-depth description requested from the student on the effects of the event and what that meant to her at that moment (instructional knowledge-analysis-description), teacher 4 intends to construe a more detailed diagnosis of the students' knowledge and reasoning.

The second relation comprised the transitions between diagnosis (pedagogical knowledge) and transmission (instructional knowledge) (see Figure 4). The high number of codes assigned to segments indicating teachers transmitting information to students does not reflect a 'sage on the stage' in a traditional sense. Instead, these segments are preceded and followed by teachers articulating intentions to construct diagnoses of the student. More concrete, this means that teachers were trying to adapt the information they provided to the students' needs.

The following two excerpts involve teacher 6 and teacher 16 responding to the second and fourth prompt of the first vignette, respectively. In this vignette the student depicted was not considering her own functioning critically. In the second prompt she declares that she lacks support from her supervisor and receives dreadful feedback. In the fourth prompt she asks for suggestions to act differently.

Errm, yes, then I would try to get her to, then I would try to make that clear and explain it and yes, it is her first, she is a first year	Transmission <sup>IK</sup> Diagnosis <sup>PK</sup>
Excerpt teacher 6; vignette 1	
Er, because she clearly, er, that, it is clear that she needs a bit more guidance So I would agree a very clear time schedule with her. Something like, er: we'll take a number of occasions to, er, come back to this later, that is what I would do with her	Diagnosis <sup>PK</sup> Transmission <sup>IK</sup>
Excerpt teacher 16; vignette 1	

In both excerpts, teachers transmitted knowledge and suggestions for taking action, based on clear assumptions regarding the student's level (diagnosis). Both teachers' transmission of knowledge, information or suggestions is actively adapted or contingent based on insights obtained from their pedagogical knowledge. This means that, based on the fact that the student at hand is a first year student, or based on teacher 16's impression that the depicted students need more guidance (pedagogical knowledge-diagnosis), the teachers provide direct suggestions for how to deal with the situation at hand (instructional knowledge-transmission).

The examples above illustrate that the teachers prioritised adapting their instructional knowledge to pedagogical knowledge with respect to their students' needs. Similarly, the significant transitions found between diagnosis and differential diagnosis (pedagogical knowledge) on the one hand and description and analysis-description (instructional knowledge) on the other indicate that teachers focused on matching instructional interventions to their diagnosis of students' needs. These relations between

aspects of teachers’ instructional and pedagogical knowledge relate to what Van de Pol, Volman, and Beishuizen (2011) and Wood (1986) conceptualise as contingent teaching. In terms of the structure and functioning of teachers’ knowledge base, these examples show that teachers frequently articulate the intention to transmit knowledge, information or suggestions based on careful considerations that originate from their pedagogical knowledge base (diagnosis).

**Relations between articulated elements from teachers’ instructional knowledge base**

Relations between elements from teachers’ instructional knowledge base were manifest in the significant transitions between transmission and safe environment at the one hand and between analysis-perspective taking and analysis-critical at the other (see Figure 5). Both relations are illustrated below.

Firstly, teachers articulating the intention to transmit knowledge was significantly more often preceded and followed by segments in which teachers aimed to provide students with a safe environment. The following excerpt comprises teacher 21’s response to the second prompt of the fourth vignette. In this vignette the student states that because her colleague is busy, she thinks she should be able to handle the situation by herself.

You find it difficult to change the adhesive bandage, I can imagine that But to leave it there is absolutely not an option, so yes, you have to find a solution to that, and that is probably, or rather, that is, with your colleague or supervisor Excerpt teacher 21; vignette 4	Creating safe environment <sup>IK</sup> Transmission <sup>IK</sup>
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This excerpt demonstrated that teacher 21’s intention to transmit knowledge is related to her intention to create a safe learning environment for the student. More concretely, the teacher states that she can imagine that it is difficult to change the adhesive bandage (instructional knowledge-creating safe environment) directly followed by providing the student with direct instructions expressing the need to discuss the event with a colleague or supervisor in order to find a solution (instructional knowledge-transmission), and this reflects a coupling between the aforementioned aspects of teachers’ instructional knowledge base. The associations found between these instances of instructional

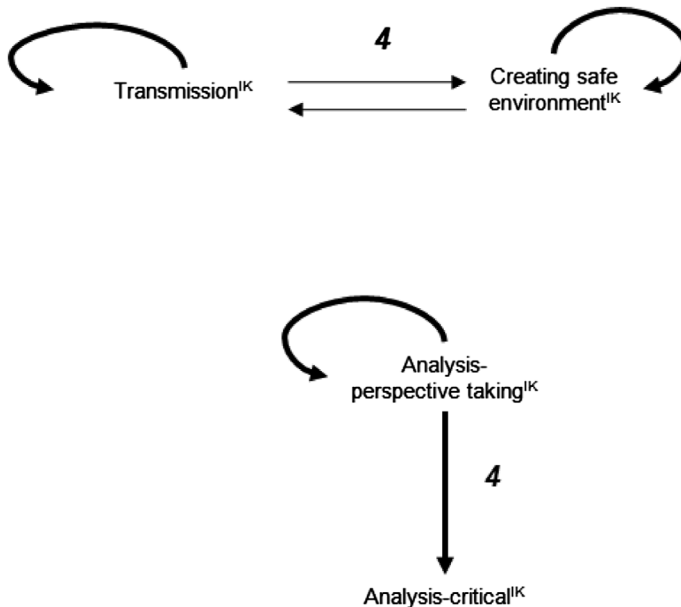


Figure 5. Transition diagram displaying the relations between articulated elements from teachers’ instructional knowledge base.

knowledge show that teachers intend to create a safe learning environment for their students when providing them with direct instructions (instructional knowledge-transmission).

The following excerpt illustrates the second relation between elements (i.e. transition between analysis-perspective taking and analysis-critical) of teachers' instructional knowledge base (see Figure 5). In this excerpt, teacher 33 responds to the first prompt of vignette 1 where the student is not considering her role in a critical and professional way.

And I would confront her, with issues that others have observed and, eh I would ask her for a reaction: what do you think when you hear from someone, ehh, that there are critical remarks? Excerpt teacher 33; vignette 1	Analysis-perspective taking <sup>K</sup> Analysis-critical <sup>K</sup>
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This relation shows that when teachers articulate the intention to confront the student with other perspectives, such as from colleagues (instructional knowledge-analysis-perspective), this is frequently followed by segments where the student is requested to, based on being confronted with other perspectives, critically reflect on their own behaviour, knowledge and attitudes (instructional knowledge-analysis-critical). This transition means that when teachers intend to stimulate their students to critically question and judge their own behaviour, knowledge and attitudes, they frequently confront their students with other perspectives.

## Conclusion and discussion

In the current study, we investigated the structure of the knowledge that experienced teachers draw on when promoting vocational students' reflection. In specific, we investigated the extent to which teachers employ curricular, pedagogical and instructional knowledge when reacting to common situations in the context of stimulating vocational students' reflection (first research question) and how these elements of teachers' knowledge are connected (second research question). In order to comply with three important requirements for investigating teacher knowledge, we (1) focused on examining and operationalising teacher knowledge in a particular content domain (i.e. fostering nursing students' reflection), (2) employed video vignettes to directly elicit and capture teacher knowledge as it is enacted in authentic teaching situations and (3) investigated relations between elements comprising teachers' knowledge.

*Research question 1: Which elements of teachers' knowledge are activated when promoting vocational students' reflection?*

The mean percentages of assigned codes indicate that teachers articulated far more pragmatic reflection goals in comparison with the other goals. In particular, goals related to judgement and understanding were comparatively infrequently expressed. These findings may be explained by the teachers' frequently articulated intention to construct diagnoses at the level of the individual student (pedagogical knowledge). Based on these diagnoses, teachers may have inferred that it may not be possible to stimulate students' reflective judgement and understanding (cf. Procee 2006) because that might be beyond the reflective capacity of some students, especially first year students in secondary vocational education. In other words, instead of seeing these results as an indication that teachers did not know about these other goals, one might view these findings as confirmation that the teachers were aiming to teach to the level of their students (Van de Pol, Volman, and Beishuizen 2011; Wood 1986). As an alternative, teachers chiefly focused on attaining pragmatic reflection goals and transmitting information. The relations between curricular knowledge and instructional knowledge (relation 2; see Figure 3), that were found to consist of a significant transition between segments that were coded as transmission and pragmatic, respectively, may support this interpretation of our results.

*Research question 2: Which relations between different elements of knowledge are characteristic for the structure of the teachers' knowledge base pertaining to stimulating vocational students' reflection?*

Based on our transition analysis on coded segments in teachers' verbal responses to the prototypical and critical situations with regard to fostering reflection in vocational students in the video vignettes, significant relations were found between teachers' curricular, pedagogical and instructional

knowledge (see Figure 1). Four salient relations between elements of teacher knowledge emerged from our analysis: teachers' (a) instructional knowledge as instrumental to construing pedagogical knowledge; (b) instructional knowledge contingent on pedagogical knowledge; (c) instructional knowledge and curricular knowledge related to fostering critical reflection; and (d) instructional knowledge and curricular knowledge related to fostering planning.

Firstly, teachers' instructional knowledge (e.g. stimulating descriptive activities when aiming to foster reflection) not only informed pedagogical knowledge (e.g. diagnosis of a particular student) but was also based on teachers' pedagogical knowledge (see relation 3; see Figure 4).

Secondly, the high number of assigned codes indicating teachers transmitting information to students was frequently preceded and followed by teachers constructing diagnoses (relation 3; see Figure 4), showing that teachers prioritised adapting their instructional knowledge to pedagogical knowledge with respect to their students' needs. Similarly, the significant transitions found between diagnosis and differential diagnosis (pedagogical knowledge) on the one hand and description and analysis-description (instructional knowledge) on the other (see Figure 4) indicate that teachers focused on matching instructional interventions to their diagnosis of students' needs (Pratt and Savoy-Levine 1998; Van de Pol, Volman, and Beishuizen 2011; Weinert, Schrader, and Helmke 1990).

Thirdly, curricular knowledge involving either critical or pragmatic reflective goals, typically framed both pedagogical knowledge (relation 1; see Figure 2) as well as instructional knowledge with regard to fostering reflection (relation 2; see Figure 3). This means that teachers' curricular knowledge not only relates to pedagogical knowledge (diagnosis of a particular student) to substantiate their goals when stimulating students to reflect, but it also inspires them to articulate intentions to confront students with other perspectives (instructional knowledge) that in turn relates to stressing students' critical thinking (relation 4; see Figure 5). In more detail, these findings indicated that teachers had more confidence in stimulating critical thinking by dialogic means (*analysis-perspective taking*) than by descriptive or critical means of reflective thinking. In most cases, teachers might have perceived a dialogic approach as potentially more successful for students, i.e. the confrontation with perspectives of others rather than a descriptive or critical approach.

Finally, we found a bilateral significant transition between pragmatic curricular goals and the articulation of methods and strategies to stimulate students' planning from an instructional knowledge base (relation 2; see Figure 3). This indicates that teachers based their interventions for stimulating students' planning on mainly instrumental rationales, which may also be related to how they diagnosed individual students' levels.

These results are in line with Kreber and Cranton's (1997, 2000) classification system of teachers' knowledge systems, but also add to it by showing how different categories of teacher knowledge interrelate and/or frame and inform each other.

This study moves beyond findings obtained in previous studies, providing an additional understanding of how different knowledge elements within a teachers' knowledge base connect to one another when teachers respond to common situations in the context of stimulating vocational students' reflection. We aspire that the detailed account of the results reported in this study and the method employed to analyse relations between teachers' curricular, pedagogical and instructional knowledge will be of use for studying teacher knowledge in other domains and in other international contexts.

### Limitations

This study has two limitations. Firstly, teachers' knowledge was measured based on evidence collected from their responses to video vignettes. An authentic dialogue with students, wherein the discourse takes multiple turns, and teachers experience a real-life relationship with their students, may yield different results. However, the advantage of the vignette-instrument was that multiple distinctive situations could be covered in the interviews, so as to enable teachers to articulate their knowledge for several authentic teaching contexts. Indeed, this means losing some of the proximity to real-life teaching, but by using the same interview protocol in all 36 interviews and having each teacher individually

respond to each of the vignettes, we gain – in a first step – a more direct and more comparable insight into the teachers' knowledge than we would have had based on teachers' individual responses to 36 videos of different dialogues (cf. Kaiser et al. 2015). In addition, the vignette interview allowed us to more directly assess teacher knowledge as it is employed during actual authentic teaching than would have been possible in an interview after a lesson or a stimulated recall interview.

Secondly, although we collected information on teachers' intentions with respect to their behavioural repertoire, results were not related to data on their actual teaching behaviour. Nevertheless, this study provides a basis for further understanding of the structure of teacher knowledge in terms of how different elements of teacher knowledge relate to each other. We contend that the more understanding we gain of these dynamic knowledge structures, the more we may get to understand what goes on in the minds of teachers during 'reflection-in-action' in complex teaching practice.

Supplementing and validating our methodological approach with analyses of authentic dialogues between teachers and their students may be useful to further our understanding of the structure and functioning of teacher knowledge with regard to fostering reflection in students. In addition, the video vignette interview can be complemented with follow-up questions to prompt teachers for explanations of their responses to the vignettes. However, since the aim of our study was to illuminate relations between articulated and categorised elements of teachers' knowledge in response to a particular common authentic problem in the context of stimulating reflection in vocational students, the relations found seem quite representative of the actual context in which the study was carried out. Future research may involve investigations on how the relations found in this study could be used in the context of teacher training.

## Implications

In our study, we found that curricular knowledge involving either critical or pragmatic goals, typically framed and provided the rationales for both pedagogical knowledge (relation 1; see Figure 2) as well as instructional knowledge (relation 2; see Figure 3). This means that in teacher training, goals for stimulating reflection need to be addressed as important guides for teachers in diagnosing students' needs as well as for instigating instructional interventions. Explicating these relations in teacher training may stimulate teachers to think about their rationales for particular teaching activities in order to come up with ways to improve their teaching for reflection. In addition, in line with the requirement to take teachers' concerns as a point of departure in teacher training (Day 1999), teachers' primary focus on diagnosing students' needs and levels, and adapting teaching accordingly (see relation 3; Figure 4), should be an important starting point in a professional development context. This also indicates that teacher training settings need to acknowledge the importance of teachers' pedagogical knowledge with regard to stimulating students' reflection.

Furthermore, discussing the video vignettes, mediated by the taxonomy for discerning teacher knowledge, may be useful to assist teachers in developing their knowledge with regard to fostering reflection in students. In the current study we found that teachers primarily focused on pragmatic goals for stimulating students' reflection. Making them aware of goals related to judgement and understanding could assist teachers in expanding their knowledge. This may be, for instance, realised by, after having teachers react to the vignettes in a training setting, further elaborating with the teachers on the vignettes. A trainer might point participants to theoretical notions on fostering students' reflections as derived from the conceptual framework in our study during such a discussion, and, based on their own reactions, the trainer may contextualise these notions to the participants' actual teaching practice. The results from our study may be used as exemplars for further discussion. Such a training could make teachers more knowledgeable about various goals concerning stimulating reflection and instructional strategies to foster such goals, and might assist teachers in capitalising on pedagogical information on students' needs in their actual teaching practice, and in ways to improve the quality of students' reflective thinking processes, thus further developing the pedagogy of reflective thinking.

## Note

1. Each segment provides the verbal transcript of teacher responses to the vignette interview questions in the first column, followed by assigned knowledge and object codes, respectively. Superscripts are abbreviations for curricular knowledge (CK), pedagogical knowledge (PK) and instructional knowledge (IK).

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## Appendix 1. Overview of the vignettes

### Vignette

1. Aliya has been given an extension to her internship because she does not stick to agreements made and she does not behave professionally with patients. Aliya, however, does not see any problem and is not amenable to feedback; she does not consider her role critically or take responsibility for her own development. Aliya is a first year student whose professional behaviour is frequently disappointing.

When you ask Aliya to reflect on her internship, she says: 'Everything is going just fine, I enjoy the work I am doing' (video)

Subsequent reaction from Aliya: 'My supervisor is never available when I need her and afterwards I always hear that what I did was wrong!' (video)

Imagine Aliya subsequently says: 'That's what I always say, is that a problem?'

Imagine Aliya subsequently says: 'How can I do it differently next time?'

2. Returning from one of her first internships, Susan says that she's noticed that many staff do not follow the hygiene measures that are taught at school. Most people, for instance, work with watches on their wrists and with long polished nails, while at school she was taught that this is unhygienic. Susan gets confused and is indignant. Susan is a first year student who normally obtains good results.

She says: 'What they tell at school is so outdated!' (video)

Subsequent reaction from Susan: 'Well, but nobody says it's wrong!' (video)

Imagine Susan subsequently says: 'Now I'm confused, at school I learnt this and when I go on internship they do it differently. What should I do now?'

Imagine Susan subsequently says: 'What can be wrong with long nails? I wash my hands 5 times a day!'

3. During a group lesson to practise communication skills, students participate in a role-play in which they have to practise providing an explanation. One student, Yashmin, has to explain to a family that a patient will be transferred to a different ward at a different location. Yashmin does not speak to the family politely and she does not show empathy. Yashmin does not see the value of the exercise and does not have a clear view of what is expected from her as a nurse in communicating with patients and their families. Yashmin is a second year student whose professional conduct is often below standard.

Afterwards you ask Yashmin to reflect on how she handled the conversation. She says: 'Everything went well, it was a good conversation' (video)

Subsequent reaction from Yashmin: 'Well, a role-play is totally different from the real situation! I cannot learn how to have such a conversation this way!' (video)

Imagine Yashmin says: 'Well, everybody was watching me! You don't have that in practice'

Imagine Yashmin says: 'Well, how can I react more empathetically to the family?'

(Continued)

**Appendix 1. (Continued)**

4. Returning from her internship, Diana talks about a situation in which she was uncertain how to act. She talks about a patient who suffered a great deal of pain during wound care, which caused him to be angry and irritated with her. Against instructions, Diana decided not to dress the patient's wound the following day, but leave the adhesive bandage one more day. She did not inform her senior colleague about the patient's pain or ask her colleague for help. Diana is a second year student with average performance.

Diana says: 'I don't know if I did it properly. Also, my colleague was busy helping a patient so I could not ask her for help' (video)

Subsequent reaction from Diana: 'Well, if she's busy and has no time, I can solve it myself, right?' (video)

Imagine Diana says: 'That patient is impossible to manage, that's also what my colleagues say. He's always this difficult!'

Imagine Diana says: 'In these kinds of situations, I usually follow my instincts. You never know what you will encounter beforehand'

5. During a conversation about her internship, Dominique indicates that she has no time to complete her school assignments. She works long hours at her internship and she has also been scheduled for the weekend shifts. Dominique says she doesn't know when she is supposed to work on all her school assignments. She has protested a little to the person who draws up the roster, but she didn't dare to say too much about it. Dominique doesn't know what to do next. Dominique is at the end of her first year, is very motivated and performs well.

Dominique says: 'They give us tedious jobs and we work twice as hard! I don't have time to do all the reports and assignments!' (video)

Subsequent reaction from Dominique: 'Well you say that I have to ask for more time for schoolwork and that I have to be more assertive, but they are not listening to me. Could you talk to them?' (video)

Imagine Dominique says: 'But it's not fair we have to work so much, right?'

Imagine Dominique says: 'When do I have to do these assignments then?'

6. During a conversation about her internship, Amber talks about a situation she encountered. At Amber's internship, the team discusses the most appropriate treatment for patients. During one of those meetings, where Amber is present, her colleagues propose a certain treatment for a patient. Amber thought this was not the best treatment. She had learned about an alternative treatment at school that seemed much more appropriate in this situation. She tried to express her opinion but no one listened to her. Amber is a third-year student who performs well.

Amber says: 'My colleagues said: 'This is how we've done it for years, so don't think you know better' (video)

Subsequent reaction from Amber: 'Well they don't want to listen to a trainee and I don't want my assessment to be bad' (video)

Imagine Amber says: 'I'm totally confused! We talked about so many things and I just keep having a wearisome feeling working on this ward!'

Imagine Amber says: 'So I should have more confidence in what I know?'

**Appendix 2. Analytic scheme for teachers' knowledge for fostering students' reflection**

Curricular knowledge	Articulation of knowledge and rationales on the goal of stimulating students' reflection. <i>Examples</i>
<i>Pragmatic Understanding</i>	Yes, that would indeed be my goal, to have her acquire that insight, yes. I want her to understand her own functioning and her own role in the whole learning process and the preconditions.
<i>Critical Judgement</i>	I want her to acknowledge that she has to act differently and more professionally. She has the potential to become an excellent nurse who relates theory and practice and employs them in her practice.
Pedagogical knowledge	Articulation of knowledge and assumptions enabling teachers to diagnose student characteristics and characteristics of student learning and adapt their teaching accordingly. <i>Examples</i>
<i>Diagnosis</i>	I think she is very vulnerable. This happens to first-year students, for a fourth-year student it would be different.
<i>Differential diagnosis</i>	First I want to hear her side of the story. To get her perspective. She believes that everything is going well so I would like to hear that first.
Instructional knowledge	Articulation of knowledge on methods and strategies for stimulating students' reflection. <i>Examples</i>
<i>Description Transmission Plan</i>	I would ask the student to give examples of why she thinks everything is going well at work. I would give the student suggestions of how you can do that. How would you do this differently next time?
<i>Analysis-critical Analysis-description Analysis-perspective taking</i>	If you look critically at yourself, what are you doing? What do you think? What do you feel? What do you need to learn in an appropriate way? Why do you think your patient is behaving in this way? Imagine that you are in pain, how would you respond?
<i>Creating safe environment</i>	I would first state that I completely understand her uncertainty.