



# Strengthening dialogic peer feedback aiming for deep learning in SPOCs



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## ABSTRACT

This study is focused on how peer feedback in SPOCs (Small Private Online Courses) can effectively lead to deep learning. Promoting deep learning in online courses, such as SPOCs, is often a challenge. We aimed for deep learning by reinforcement of ‘feedback dialogue’ as scalable intervention.

Students provided peer feedback as a dialogue, both individually and as a group. They were instructed to rate each other's feedback, which was aimed at deep learning. Data from questionnaires from 41 students of a master epidemiology course were used to measure for each feedback assignment to what extent deep learning was perceived. The feedback received by students who scored extremely high or low on the questionnaire was analyzed in order to find out which features of the feedback led to deep learning. In addition, students were interviewed to retrieve information about the underlying mechanisms.

The results support the view that peer feedback instruction and peer feedback rating lead to peer feedback dialogues that, in turn, promote deep learning in SPOCs. The value of peer feedback appears to predominantly result from the dialogue it triggers, rather than the feedback itself. Especially helpful for students is the constant attention to how one provides peer feedback: by instruction, by having to rate feedback and therefore by repeatedly having to reflect. The dialogue is strengthened because students question feedback from peers in contrast to feedback from their instructor. As a result, they continue to think longer and deeper, which enables deep learning.

## 1. Introduction

Higher education aims for deep learning and increasingly provides education on-line, such as through SPOCs (Small Private Online Courses). Deep learning involves critical thinking, integrating what the student is learning with what he or she already knows, and creating new connections and concepts (Biggs, 1999; Marton & Säljö, 1997; Ramsden & Entwistle, 1983). Deep learning may be a challenge in the context of SPOCs (Filius et al., 2018a) due to asynchronous, written interaction and the lack of visual cues and body language (Garrison & Kanuka, 2004; Uribe & Vaughan, 2017). Previous research (Ertmer et al., 2007; Filius et al., 2018a; Gikandi & Morrow, 2016; O'Shea, Stone, & Delahunty, 2015) suggests that peer feedback by dialogues assists in solving challenges of instructors in SPOCs to achieve deep learning. In this study we follow Duijnhouwer's definition of feedback, which is “information provided by

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an external agent regarding some aspect(s) of the learner's task performance, intended to modify the learner's cognition, motivation and/or behavior for the purpose of improving performance" (Duijnhouwer, 2010). Peer feedback contains information provided by fellow students, in contrast to feedback from instructors or books (Hattie & Timperley, 2007). Dialogic peer feedback is a two-way communication and involves students in interpretational meaning-making about the feedback (Geitz, Brinke, & Kirschner, 2015; Steen-Utheim & Wittek, 2017). Dialogic peer feedback may trigger mechanisms such as making students feel personally committed, enable students to ask and provide relevant feedback, to probe back and forth, and to understand their own learning process (Filius et al., 2018b).

In this study, the feedback dialogue is implemented in three steps: feedback instruction, feedback provision and rating, and feedback discussion. We aim to examine to what extent this feedback dialogue leads to the intended deep learning outcome, which has been operationalized by critical thinking, connecting concepts, and creating new concepts. We will also examine the extent to which this has been caused by the student mechanisms of 1) feeling personally committed; 2) asking and providing relevant feedback; 3) probing back and forth; and 4) understanding one's own learning process.

## 2. Dialogic peer feedback to promote deep learning in SPOCs

### 2.1. Deep learning outcome

In recent decades, research related to student approaches to learning has identified two main ways that students approach learning: the deep learning approach and the surface learning approach. Deep learning can be visualized on one side of a continuum where students are aiming for understanding, with surface learning on the other side of the continuum where they are aiming to memorize or reproduce the material for a test (Aharony, 2006; Biggs, 1999; Hall, Ramsay, & Raven, 2004). With deep learning the student approaches learning with the intention to understand and construct meaning, and consequently, think critically, relate new ideas to previous knowledge and search for relationships among the material (e.g. Akyol & Garrison, 2011; Biggs, 1999; Booth, Luckett, & Mladenovic, 1999; Pegrum, Bartle, & Longnecker, 2014; Trigwell, Prosser, & Waterhouse, 1999). On the other hand, surface learning is to a large extent externally focused. It is the tacit acceptance of information and memorization as isolated and unlinked facts. Learning is then focused on recalling and regurgitating information, which leads to superficial retention of material for examinations (Biggs, 1999). Students that approach learning with a surface approach, study with the intention to acquire only sufficient knowledge to complete the task or pass the course. Elements from deep learning, such as critical thinking, integrating new knowledge, and creating new connections (Biggs, 1999; Entwistle & Tait, 1990; Marton & Säljö, 1997), are important because they lead to a more personal understanding. It enables students to relate the content to personally meaningful contexts or to existing prior knowledge, theorize about what is learned, 'playing' with the task by forming hypotheses about how it relates to other known or interesting items, and deriving extensions and exceptions. Students are unlikely to reproduce high-quality learning outcomes through a surface approach to learning (Hall et al., 2004; Nelson Laird, Seifert, Pascarella, Mayhew, & Blaich, 2014). However, as said, the way to promote deep learning may be different in the specific context of a SPOC compared to face-to-face learning (Filius et al., 2018a).

### 2.2. The context of SPOCs

SPOCs (Fox, 2013) are small-scale online courses and represent a specific, defined form of fully online education. In comparison with Massive Online Open Courses (MOOCs), SPOCs are characterized with a small number of students in one class (15–20), significant instructor guidance who is often assisted by an e-moderator, significant peer interaction, and usually fixed start- and end-dates. In contrast to MOOCs, students usually start a SPOC with the intention not to just participate in part of the course, but with the intention to complete it. This, in combination with the small group and the high amount of interaction (Uijl, Filius, & Ten Cate, 2017), may be the cause of the relatively high retention rates (> 90%) (Filius et al., 2018a). Since interaction and a sense of community may be considered prerequisites for deep learning (e.g. Ertmer et al., 2007), SPOCs may be a type of online learning for higher education that has good potential to promote deep learning. However, this interaction is often asynchronous and written, without students seeing each other, which may have consequences for the choice for a deep learning approach.

### 2.3. Dialogic feedback interventions

A specific form of interaction is feedback, more specifically, dialogic feedback. Feedback is part of the interactive components of teaching and learning and can therefore be seen as central to pedagogy. The concept 'dialogic feedback' arose mainly from limitations identified from studies of feedback practices in higher education, such as not understanding the feedback, finding it too difficult to act upon, and receiving it too late (Steen-Utheim & Wittek, 2017). To overcome these limitations, the concept 'dialogic feedback' emphasizes the importance of interaction between the feedback provider and the feedback receiver beyond the initial feedback, as well as the importance of engaging in a dialogue about the feedback and therefore the feedback enables a dialogue from which can be learned (Boud & Molloy, 2013; Ormond, Merry, & Reiling, 2005; Ruegg, 2015). Thus, Carless (2013) defines dialogic feedback as "interactive exchanges in which interpretations are shared, meanings negotiated and expectations clarified" (p. 90), as opposed to feedback as a monologue from the feedback provider to the feedback receiver (Nicol, 2010) without an explicit trusting relationship (Carless, 2013). To that end, dialogic peer feedback may be considered as a form of collaborative learning because it provides students with opportunities to work interactively together and create new knowledge.

Peer feedback is the most common feedback, after instructor feedback (Guasch, Espasa, Alvarez, & Kirschner, 2013). Nicol, Thomson, and Breslin (2014) define peer feedback as an arrangement whereby students evaluate and make judgments about the work of their peers and write comments. They provide feedback on others' work and receive feedback on their own work. Students usually prefer instructor feedback over peer feedback, since peers are usually not experts. However, peer feedback may also have advantages, as peers have equal status and training, so their relationship is not disturbed by a hierarchical relationship. Moreover, the feedback is often more timely (Finn & Garner, 2011). Another advantage of peer feedback is that not only the receiver, but also the provider, may learn from it (Cho & Cho, 2011; Ertmer et al., 2007; Sapouna, 2016). By considering other students' work, students deepen their own learning and increase their motivation to learn (Trevelyan & Wilson, 2012). Providers improve their higher-level learning skills and practice to evaluate, monitor, and regulate their own learning. They may learn to reflect, become more critical, and even improve their own product. Providing peer feedback can lead to more knowledge and help students to make better evaluative judgments and to develop their metacognitive skills (Carless, 2013). Students compare and question ideas, evaluate, suggest modifications, reflect, plan, and regulate their own thinking. Feedback providers learn to think critically, connect to new knowledge, explain, and take different perspectives (van Popta, Kral, Camp, Martens, & Simons, 2017). Thus, students are offered the opportunity not only to reflect on the work of their peers, but also on their own work, which over time can lead to increased learning (Ertmer et al., 2007). And despite the evidence that peer feedback has advantages for students, authors such as Ion, Barrera-Corominas, and Tomàs-Folch (2016) state that student training in feedback skills may strengthen the advantages even more.

Hewett (2000) and Tuzi (2004) examined the use of feedback in online education, although not specifically aimed at deep learning. They emphasize the importance of peer feedback in online environments, such as SPOCs, suggesting that peer feedback can influence the students' outcomes more than in face-to-face environments because of the ease of communication, as well as the near-absence of affective factors.

Peer feedback has advantages not only for students, but also for instructors in terms of their workload. Engaging in dialogues is challenging for instructors, especially when the number of students increases. This particularly applies to higher education SPOCs, where written communication puts further strain on limited instructor capacities (Filius et al., 2018a). To the best of our knowledge, there has been no previous research into the use of peer feedback aimed at deep learning in the specific context of SPOCs. Peer feedback may provide students with personalized feedback without correspondingly increasing the instructor's workload when the student number, and thus the number of SPOCs, increases. Thus in order to meet the challenges for instructors to promote deep learning in the specific context of SPOCs we aim to examine to what extent the feedback dialogue leads to the intended deep learning outcome. Therefore we specifically selected scalable steps in the peer feedback intervention that, in our view, are most feasible in the educational practice of SPOCs. The three selected steps are: 1) Feedback training; 2) Feedback asking and receiving (written, both individual and as a group); and 3) Feedback discussion. In this study, all three have been implemented together and aim for reinforcement of the peer feedback dialogue to promote deep learning in SPOCs.

#### 2.4. Students mechanisms to promote deep learning

To increase the potential impact of peer feedback on deep learning, it is crucial also to better understand which mechanisms affect learning and how these mechanisms can be supported (Gielen, Peeters, Dochy, Onghena, & Struyven, 2010). Student mechanisms describe how students engage in learning activities, which largely determines the quality of the learning outcomes they attain (Vermunt & Verloop, 1999). All student mechanisms related to deep learning involve some type of interaction, as interaction may be considered as a prerequisite for deep learning (Cleveland-Innes & Emes, 2005). The Online Learning Interaction Model (Ke & Xie, 2009) addresses the different types of interaction that are needed for deep learning, which are social, knowledge construction, and learning regulation. We have deepened this model by descriptions of four specific mechanisms (Filius et al., 2018b). The first mechanism is 'feeling personally committed,' which means that students are personally addressed and feel part of a group, which makes them accept feedback more easily. The second mechanism is 'asking and providing relevant feedback,' which refers to knowing how to ask and provide feedback aiming for deep learning. The third mechanism is 'probing back and forth,' which describes the way students present ideas and receive feedback on these ideas by 'ping-ponging' back and forth, which requires comparing and synthesizing information, drawing conclusions, and supporting conclusions. The last mechanism is 'understanding one's own learning process,' which refers to how students understand what they have learned and what they still need to learn while applying new information in different contexts.

#### 2.5. Present study

Promoting deep learning by peer feedback has been demonstrated to be an effective instructional strategy in face-to-face education (e.g. Lynch, McNamara, & Seery, 2012). But little is known about the role and extent of dialogic peer feedback in promoting deep learning in the specific context of SPOCs. Additionally, exploring the underlying student mechanisms will deepen our understanding of the appropriate interventions. To fill this gap, the main research questions are the following:

1. To what extent does the reinforcement of the feedback dialogue (feedback instruction, feedback providing and rating, feedback discussion) in SPOCs lead to the intended deep learning outcome (critical thinking, connecting concepts, creating new concepts)?
2. To what extent are the mechanisms (feeling personally committed, asking and providing relevant feedback, probing back and forth, and understanding one's own learning process) triggered by reinforcement of the feedback dialogue (feedback instruction, feedback providing and responding, feedback discussion) in SPOCs?

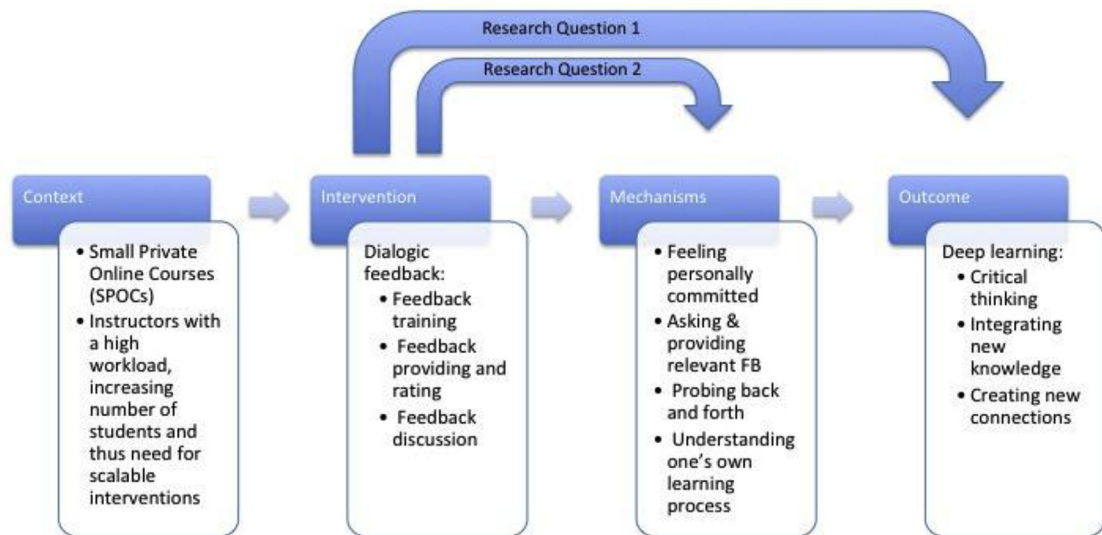


Fig. 1. CIMO-logic in this study (based on Van den Akker, 1999).

We used the CIMO-logic (van Aken, 2007; Van den Akker, 1999) to formulate the research questions. The CIMO-logic includes the problematic *Context* to which it applies, the *Intervention* proposed, and the *Mechanism* by which the desired *Outcome* is achieved. Fig. 1 shows how the CIMO-logic has been applied in this study. The problematic context is defined by the specific challenges in SPOCs when aiming to promote deep learning. Problematic contexts elucidate the context dependency of the intervention. Interventions are purposeful measures, in this case activities that are formulated by the instructor in order to solve a design problem or respond to a need (Denyer, Tranfield, & Van Aken, 2008; Midgley, 2000); in this study, the need is for deep learning in SPOCs. This is reflected in the first research question.

Van Aken (2004) indicates that the key question is not so much whether the intervention works, but what it is about the intervention that makes it work. Why does an intervention lead to a certain outcome in a specific context? This has been described in the second research question.

We expect that the results support the view that peer feedback instruction, assignments, ratings, and discussion strengthen the feedback dialogue which, in turn, promotes deep learning in SPOCs.

### 3. Methods

#### 3.1. Research design

This is a three-phase mixed-method study, consisting of 1) questionnaires using a quantitative research method; 2) content analysis method (feedback features), both using a qualitative research method; and 3) interview, using a qualitative research method.

The peer feedback dialogue has been implemented within four editions of a completely online postgraduate 'Clinical Epidemiology' course at the Utrecht University, the Netherlands, taught between November 2015 and March 2017. In each edition, students were given four individual and one group peer feedback assignments.

#### 3.2. Participants

In total, 45 students of four editions attended this course, offered through a Moodle-based virtual learning environment from Elevate Health. The students (34 women and 11 men) had ages that ranged from 24 to 56 years, with an average age of 33.3 years (SD: 7.5/Median: 31). For most students, this was their first SPOC. On average, they previously participated in 1.6 SPOC, including this one, varying in duration and study load. The maximum number of SPOCs students had participated in was 4. Students came from 9 different countries (Netherlands, Belgium, United Kingdom, United States, Canada, Saudi-Arabia, Nigeria, Zimbabwe, South Africa) in 4 different continents.

In order to rate the peer feedback, students were invited to fill in four online questionnaires. In total, 41 students completed at least 1 questionnaire and 29 students completed all 4 questionnaires, which gives a response rate per assignment ranging between 91% and 62%.

From each course edition we selected all feedback dialogues that were either very high or very low rated by the feedback receivers. The collection of the high rated cases has been referred to as 'positive deviance' (Marsh, Schroeder, Dearden, Sternin & Sternin, 2004). We decided to compare the highest rated feedback to the lowest rated feedback, so we could assess which features of this feedback were distinctive. Feedback that was given the highest grade (4) by peers on all questions about deep learning is

**Table 1**  
Questionnaire.

Please answer each question with a grade (1: not at all, 2: little, 3: much, 4: yes, certainly) and explain:

1. Did you find the feedback useful?
2. Did it help you to think critically?
3. Did it help you to integrate what you are learning with what you already knew?
4. Did it help you to make connections with other knowledge?
5. Do you have any suggestions to improve the feedback?

considered the highest rated feedback and ranged per assignment from 52% to 66% of all rated feedback. Feedback that was given the lowest grade (1) on at least one of the questions about deep learning is considered the lowest rated feedback and ranged per assignment from 11% to 18% of all rated feedback. The percentage of high and low rated feedback is about equal in all 4 editions. In total, feedback had been given to individual assignments 148 times. From the 45 students in total, 41 students finished at least one assignment, received peer feedback, and responded to the feedback received. 29 Students finished all five assignments, received peer feedback, and responded to the feedback received.

After finishing the course, all students from the first and the third edition of the course were invited to be interviewed. From these 28 students, 20 agreed and were interviewed. Also, the course instructor has been interviewed. Data analysis of the interview content indicated that all themes reached saturation, meaning additional interviews would probably not add to the depth or breadth of the data.

### 3.3. Measures

#### 3.3.1. Deep learning

In order to map the students' perceptions on the extent to which deep learning had been achieved, a questionnaire was developed with items concerning the usefulness, critical thinking, integrating what the student is learning with what he or she already knows, and creating new connections and concepts. The latter three items constitute the operationalization of deep learning based on Biggs (1999), Entwistle and Ramsden (1983), and Marton and Säljö (1997). In asking for the occurrence of deep learning, we used a fully anchored four point scale, where 1 = no and 4 = yes. We deliberately did not choose a 5-point scale in order to prevent students from scoring in the middle. Each time students completed an assignment and received peer feedback, students were asked to fill in the questionnaire with questions as shown in Table 1.

The questionnaires not only measure the frequency and the extent of the perceived deep learning outcome, but also examples and explanations using open questions as shown in Table 1. The response for each assignment of the 45 students ranged from 60% to 91%, equally divided over the four assignments.

#### 3.3.2. Peer feedback features

The feedback received by students that was rated extremely high (a score of 4 on all items) or low (a score of 1 on at least 1 item) on the questionnaire was analyzed and coded in order to measure which features of the feedback led to deep learning. Content fragments were labeled using the following codes, based on the features of feedback to promote deep learning (Filius et al., 2018b): 1) Argumentation; 2) Suggestion for improvement; 3) Theoretical source; 4) Relevant question; and 5) Other.

#### 3.3.3. Mechanisms

To measure the mechanisms, a first coding schema has been derived from literature (Filius et al., 2018b). Next, the transcripts of the interviews were deductively coded by using the four mechanisms, while keeping an eye open for new mechanisms. We refined the coding schema twice by using labels mentioned by the interviewees. The final codes are shown in Table 2. The complete coding scheme consists of a description and examples of each code.

### 3.4. Procedure

After each assignment, students underwent the intervention in three steps: 1) Feedback instruction and feedback ratings; 2) Feedback providing and rating; and 3) Feedback discussion.

Step 1 consisted of feedback instruction, in which students were told in both text and video how to aim their feedback specifically at deep learning. They were asked to provide feedback, including asking the right follow-up questions. Students were also shown examples of feedback aimed at deep learning (as a good example) and examples not aimed at deep learning (as a plausible bad example) Two examples can be found in Fig. 2a, b, and 2c. Thereafter, the students were constantly reminded of the content of the video during different parts of the course. Students continuously had the option to ask questions or discuss the assignment.

During step 2, feedback providing and rating, students were asked to submit a written assignment. The first four assignments were

**Table 2**  
Mechanism codes.

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Mechanism 1 'Feeling personally committed'
- Get to know each other; bonding
- Committed to the content
- Feel vulnerable
- Improve motivation
Mechanism 2 'Asking and relevant rating peer feedback'
- Learn new perspectives
- Search for new knowledge
- Improve feedback skills
- Reflect and express
Mechanism 3 'Probing back and forth'
- Interact quickly versus asynchronous
- Ask in-depth questions and formulate suggestions
- Question each other
Mechanism 4 'Understanding one's own learning process'
- Compare own arguments with that of the peer

---

individual assignments, and the fifth assignment was a group assignment. On the group assignment, students had to submit an agreed document and were asked to provide feedback to a group instead of an individual. Each assignment consisted of four questions about a scientific article. For each assignment, the provision of feedback to at least one submission of their peers was mandatory, using predetermined rubrics with guidelines and criteria. Feedback providers were required to use arguments (qualitative feedback) and were able to add grades (quantitative feedback). Feedback and responses were only visible for the feedback provider, feedback receiver, and the instructor.

Each of the subsequent peer feedback instructions was part of a process of fading and transfer of responsibility (Van de Pol, Volman, & Beishuizen, 2010). This means that instructions became less detailed, aiming to increasingly challenge the feedback provider and improve the feedback skills. After providing and receiving peer feedback, the feedback receiver had to tell the feedback provider how he or she experienced the feedback each time.

Thereafter, during step 3, the students could continue their dialogue in a discussion forum. This required, however, the navigation to a different location in the virtual learning environment. Moreover, the discussion forum was visible for all students, in contrast to the assignments, feedback, and feedback ratings.

Interviews were used to ask for the underlying reasons and mechanisms that were triggered in order to promote deep learning. The interviews allowed for deeper probing into positive and negative effects on the intervention steps and into the mechanisms that have been triggered by the intervention, as well as exactly how they were triggered. We were specifically focused on the occurrence and details of mechanisms and interventions, and not on how many participants mentioned them. To encourage discussion, a semi-structured interview sheet was used for all interviews, which contained the questions shown in Appendix 1.

To ensure quality in all of the steps described, an audit was conducted by an independent researcher concerning all steps of data gathering and analysis (Akkerman, Admiraal, Brekelmans, & Oost, 2008). The audit had both a formative and a summative function. Consequently, the auditor assessed the steps taken several times during the study and at the end of the study. This resulted in an audit report with questions and answers, mostly about the analysis of the data. It also led to some adjustments in the description of the analysis in this article. Thereafter, the auditor reviewed the study again and confirmed it as being visible, comprehensible, and transparent. According to the auditor, decisions are explicated and communicated, decisions have been substantiated, and decisions are acceptable according to standard values and norms.

### 3.5. Analysis

#### 3.5.1. Research question 1

The results of the questionnaires were taken as a starting point for the analysis to answer the first research question. In the questionnaire, we counted the frequency of the deep learning outcome (the dependent variable) as reported by the students.

Next, to find out which elements of the feedback dialogue (the independent variable) specifically led to deep learning, we analyzed the content of the peer feedback to compare peer feedback in the learning environment with the ratings of the students in the questionnaires to find patterns in the features of the peer feedback given. The highest rated cases were compared to the lowest rated cases to assess which features of this feedback were distinctive.

To enhance reliability in coding, an independent researcher also analyzed a random sample of approximately 10% of the data for calculating the inter-rater reliability. The percentage of agreement was 88%.

#### 3.5.2. Research question 2

To answer the second research question, we analyzed the interviews using thematic analysis and iterative coding to determine which mechanisms did or did not occur. Transcripts of the interviews have been read thoroughly to ensure understanding of their content and to assign codes to text segments. Then, codes were developed based on constant comparison and contrasting of data across the different interviews. The second step of analysis involved identifying themes and trends, while the third step consisted of

**Assignment:**  
The student will receive an article and be asked to answer the following question: "Is the study diagnostic, etiologic, prognostic or intervention? Name at least two characteristics that underpin your answer."

**Right answer:**  
This study is best categorized as a prognostic study. Some of the characteristics the student might answer:

1. This study aims to predict the future occurrence of a health-related outcome based on the patient's clinical and non-clinical profile.
2. This study provides quantitative knowledge about the occurrence of a health outcome in a predefined time period as a function of multiple predictors.
3. This study is longitudinal. The object of the prognostic process is inherently longitudinal. Accordingly, prognostic research follows a longitudinal design in which the determinants or prognostic predictors are measured before the outcome is observed.
4. The study aims for answers that are collected prospectively rather than retrospectively.
5. All consecutive patients with a particular condition who are at risk to develop the outcome of interest are included, but the potential prognostic determinants as well as the outcome are measured in all patients.

a)

**Example 1 of an answer of a student:**  
I think it is a prognostic study.

- In my opinion the central question of the study is: 'What is the prognosis if I do not intervene?' . This is a prognostic question and not an intervention question. For an intervention question you examine the effects of an intervention.
- Further the study is not causal but descriptive.

**Example 1 of feedback aimed at deep learning:**  
You are right about the type of study and the central question of the study. Could you please elaborate on your second argument? In your opinion, what exactly does the study describe? And why would you say that this is a characteristic of a prognostic study? Would that exclude other study types? Please keep in mind what you might have read in the book for this course 'Clinical Epidemiology' about prognostic research on page 116.

**Example 1 of feedback not aimed at deep learning:**  
Yes, the type of study is correct and so is the first characteristic. The second characteristic doesn't seem to be right.

b)

**Example 2 of an answer of a student:**  
I think it is a prognostic study.

- The study uses a case control design: family members of sarcoidosis cases or non-family members
- The study examines the predictive variable 'sarcoidosis familial relative risk'

**Example 2 of feedback aimed at deep learning:**  
It is a prognostic study indeed. You are also right about examining the predictive variable 'sarcoidosis familial relative risk'. Please elaborate on why you think it is a case control design. How did you come up with those two groups? How exactly are the population and the group of respondents defined in the article? Please keep in mind what you have watched in the last lecture of this Learning Unit about prognostic research. Next time you do an assignment like this I recommend to describe what this study design distinguishes from other study designs.

**Example 2 of feedback not aimed at deep learning:**  
Yes, the type of study is correct: it is a prognostic study. Good job. Your first argument is wrong, the second one is right. Please take look at the article and the book once more.

c)

**Fig. 2.** a: Example of an assignment and the instructor's answer. b: Example of 1 × answer and 2 × feedback. c: Example of 1 × answer and 2 × feedback.

developing, testing, and retesting propositions for constructing an explanatory framework (Miles & Huberman, 1994). To aid in the coding and retrieving of the data, DeDoose software was used.

To enhance reliability in coding, an independent researcher also analyzed a random sample of approximately 10% of the data for calculating the inter-rater reliability. Internal validity was further enhanced due to the description of the results, which were context-rich and meaningful.

**Table 3**  
Student feedback ratings.

Average number on scale 1 (not at all) to 4 (yes, very much)				
Assignment	Useful	Critical	Integrating	Connections
1	3.7	3.8	3.7	3.4
2	4.0	3.9	3.6	3.3
3	3.8	3.6	3.5	3.3
4	3.8	3.6	3.4	3.3
5	3.9	3.4	3.2	3.2
Average per total	3.9	3.6	3.5	3.3

Remarkably, the average score for usefulness is 3.9, which is higher than the average score for the other elements of deep learning.

## 4. Results

### 4.1. Deep learning

Results from both the interviews and questionnaires indicate that the intended deep learning outcome (critical thinking, connecting concepts, creating new concepts) has occurred in the majority of the feedback assignments and in the majority of the participants. Respectively 94% (critical thinking), 90% (integrating new knowledge) and 86% (connecting new concepts) has been achieved in some degree (little, much or certainly), according to the feedback receivers. If at least one out of these three had been achieved, it was always 'critical thinking'.

An overview of all ratings per assignment can be found in Table 3. However, based on the open questions in the questionnaire, some students indicate that they consider 'integrating new knowledge' and 'creating new concepts' as not completely separate from each other and say that they are not easily distinguished. This is in contrast to 'critical thinking,' which may be easier to indicate if this led to deep learning.

### 4.2. Feedback dialogue intervention

In this study, feedback training, feedback providing and responding, and feedback discussion were implemented to strengthen the peer feedback dialogue. We will discuss to what extent these three steps were helpful in promoting deep learning.

#### 4.2.1. Step 1: feedback training

According to the interviews, the majority of the students experienced the feedback training as valuable in learning how to specifically aim for deep learning. According to them, the important elements of this instruction were 1) explanation of how to be critically constructive; 2) the need to pay significant attention to the arguments (more than judgment); and 3) how to work toward a dialogue. The latter means that the feedback provider does not have to give the right answers on the assignments, but more importantly, must ask questions to trigger the other to think deeply and, for example, consider alternatives. Therefore, the feedback provider and feedback receiver had to really engage with each other so that they could ask and respond to one another. Although asking questions certainly helps, one should not ask too many questions at once, as some of the interviewed participants said. One of the interviewees illustrated the need for questions as follows: "Sometimes the question was specifically asked: 'How could you prevent this?' or 'How could the study be better set up?' or 'How could they handle those deficiencies?' Yes, then you are challenged to think critically, and then I think that learning is happening more and more than when the answer is given and it simply says 'You did not mention this or that.' or 'Okay, that's right.'" (S1).

Results from the interviews on the most important elements of the instruction are supported by the observations of the peer feedback. Results of the observations, visualized in Fig. 3, show that feedback rated as very high (based on the answers to the questions described in Table 1) nearly always (99%) explains the arguments why an answer may (not) be right, often add their own perspective (88%) and add suggestions for improvement (87%) in contrast to rated as very low (respectively 20%, 23% and 14%). Based on the differences between high and low rated feedback, a theoretical source (14% vs 89%) may not add much value to deep learning.

#### 4.2.2. Step 2: feedback providing and rating

The peer feedback assignments provoked a dialogue, meaning that there are many possible good answers on the assignments, which made the arguments more important than the answer itself. Students found this type of assignment to be helpful in stimulating the dialogue between feedback provider and feedback receiver. One of the interviewees expressed this as follows: "I think it'd be most valuable to go back and forth about ideas, when there isn't a right answer, when there could be lots of right answers, and talking about why is this answer better than that answer, even though all of them could be correct, all of them could be wrong." (S16).

Students received rubrics to help them providing feedback. The rubrics were formulated as guidelines instead of correct answers for the assignments. Based on the interviews, the guidelines enhanced the dialogue more than correct answers would have. Students also said that the structure and sequence of the increasingly less detailed instructions for feedback providers were useful in promoting



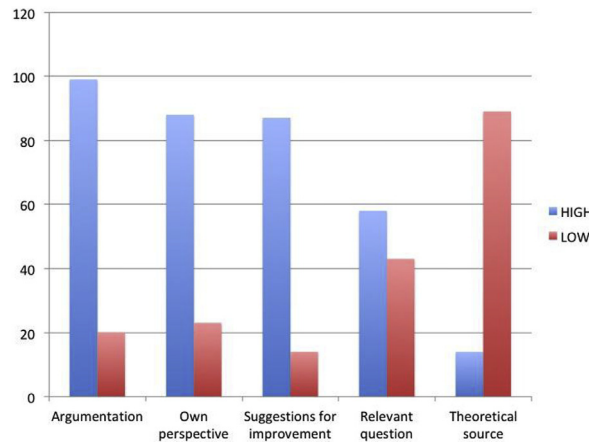


Fig. 3. Feedback features, as found in the extremely high and low rated feedback.

deep learning, because fewer details necessitated more thinking from the feedback provider.

Subsequently both the interview results, as well as the results from the questionnaires, indicated that it was helpful if the feedback provider gave suggestions that made the feedback receiver think again, reflect, and reconsider the answers given on the assignments. Feedback had to be given in arguments and a grade could be added. The majority of students preferred solely arguments, without grades, to emphasize that the aim is learning, not assessing.

For the group assignments, in order to give feedback aimed at deep learning, some students suggested showing not only the answers on the assignment, but also the discussion that preceded the results. In order to promote deep learning, it may be helpful to provide feedback on both the answers (the result) as the discussion (the process).

After receiving peer feedback, students were asked to rate the feedback they received. Most, although not all, interviewees found that making and receiving the ratings was very useful for both deep learning about the content, as well as for developing feedback skills. They also indicated that rating forced them to not only read the feedback more accurately, but also to “look again, critically, at your own assignment, but now from a different perspective” (S16).

Lastly, many participants stated their preference for (added) instructor feedback.

#### 4.2.3. Step 3: feedback discussion

Students in this study made little use of the feedback discussion to continue their dialogue after the response of the feedback receiver. In the interviews, students indicated that this is partly due to the time difference between action and response, since all interaction is asynchronous. “That’s just a bit tricky about this concept, of course, there is a delay of one night sleep. And that, of course, takes away the learning effect, because your mind is already somewhere else,” (S9) as an interviewee expressed. Based on the interviews, the lack of back and forth probing after the response to the feedback provider may be due to various reasons, such as 1) it was a non-mandatory learning activity; 2) it required students to navigate to a different location on the virtual learning environment; 3) it required students to asynchronously discuss a previous assignment; and 4) in the course the next topic was already addressed. Lastly, the discussion, as opposed to the feedback and feedback ratings, was visible to all students, which increases the threshold for posting since some students prefer to ask and receive feedback in private.

#### 4.2.4. Scalability of interventions

In an interview, the instructor indicates that students indeed come to a deeper interaction, without contributing to a higher workload for the instructor. Even though the number of students varied through the different editions of the course, the time spent by the instructor remained more or less the same. The peer feedback also clearly took less instructor time than it would have in the case of instructor feedback. A downside that was mentioned is that not looking at the peer feedback assignments at all means a loss of quality control. Two students propose to solve this dilemma by rating, for example, a randomized 10% of the peer feedback during an online plenary discussion. The instructor notices that investing in teaching students how to provide dialogic feedback may come at the expense of teaching students the subject matter.

### 4.3. Mechanisms

In this study, the student mechanisms ‘feeling personally committed,’ ‘asking and providing relevant feedback,’ and ‘probing back and forth’ have been examined. We will discuss to what extent these mechanisms were triggered by the peer feedback intervention.

#### 4.3.1. Mechanism 1 - feeling personally committed

Providing peer feedback seems to help students to feel personally committed, because it gives them a reason to interact with each other, as several interviewed participants report. They explained that having a reason to interact with each other seems to be more

important than in face-to-face education, where informal chats are easier. They get to know each other, give each other compliments, and have the opportunity to build a constructive and safe atmosphere in which they encourage each other to choose a deep learning approach, as the majority of the interviewees indicate. By discussing what they have learned, students feel more personally connected to the course content, as some of the interviewed participants report. *"It was just I felt I could connect with my other peers. Their opinion was valuable to me and I learned something new. And I could tell others. So that phase was good as if I was relating to what I've learned. And I could connect to the others. It was like fun to express what I learned, I liked that, yes."* (S8). Several (4) students mentioned that feedback created an atmosphere in which they dared to be vulnerable: *"And that's the case with feedback, because it's got something very vulnerable. Because you are being watched very closely, and at the same time that's what makes it very interesting as well. And I think that is very strong."* (S4).

This mechanism was more easily triggered in the group assignments than it was in the individual assignments. The process of getting to know each other and feeling connected seems to be stronger when collaborating on the same assignments.

#### 4.3.2. Mechanism 2 - asking and providing relevant feedback

The peer feedback assignment helped students to provide each other with feedback focused on learning instead of an assessment, as many of them stated during the interviews. One of the interviewees illustrated this as *"It's learning, because you really need to think about: 'How did this person do this assignment and what do I think of this?'"* So that was a reason for me to get the book again and ask myself: *'Do I agree with this? And how can I help this person to go even deeper?'* So that's educational, yes." (S35).

Receiving relevant peer feedback challenged the students to consider other perspectives and to re-read course materials. This rethinking of the course material seems to lead to a deep learning approach, as was indicated many times both during the interviews and in the questionnaires.

Providing peer feedback requires students to reflect and think about how to explain to peers what they have learned and how they can transfer their knowledge to the specific assignment. Receiving feedback on their feedback afterward made them realize the how they could improve their feedback skills aimed at deep learning. Several students mentioned that they re-read the course materials in order to better understand the course content and provide the best peer feedback.

The majority of the interviewees mentioned that providing peer feedback promotes deep learning more than receiving peer feedback does, because it stimulates reflection on what they have learned, critical thinking about the answers on the responses of the peer, and careful formulation of their opinion.

#### 4.3.3. Mechanism 3 - probing back and forth

After the feedback has been given and rated, many students started comparing each other's arguments, as they said in the interviews. Next, in line with the feedback instruction, students tried to ask in-depth questions about the answers their peer had given. *"Mostly, I found the feedback I received very sensible, and it really encouraged me, like: 'You may want to check this again' or 'Have you thought about this direction?' And 'Could you tell us the difference between this or that', for example. These are very nice suggestions, which really make you think deeper."* (S12). As some of the students stated, accepting feedback from peers is different than from instructors: *"From an instructor you easily accept the feedback, but with peers, it is different, you don't just take it as the truth but you'll rethink it. And then you respond and then your peer responds and then you think 'oh, they meant it like that, okay, now I get it'. From that discussion I learned a lot."* (S38).

This mechanism was more easily triggered in the group assignments than it was in the individual assignments. Collaborating on the same assignments often requires interaction between the students in one group in order to gain a shared understanding and develop a shared plan of action. Furthermore, once there are more group members who are able to respond, there is more and quicker probing back and forth compared with the interaction between one feedback provider and one feedback receiver: *"During the online debate, during the group assignment, it was very intense, we learn a lot, even though maybe we were online for like only two hours, but the discussion was very intense"* (S14).

#### 4.3.4. Mechanism 4 - understanding one's own learning process

A few students reported that the perspectives of their peers clarified where they were in their learning process and what they still had to learn. *"You get an insight in how far you are. What your answer is, how you think about it, and how other people get along. And that gives you a feeling of 'do I really understand this?' Should I really understand this?'"* (S38).

Several students mentioned that the peer feedback assignments, both receiving and providing, encouraged them to study the course content again. They assumed that this repetition makes deeper thinking possible and may cause deep learning.

## 5. Discussion

This study focused on how dialogic peer feedback in SPOCs can effectively lead to deep learning. Results support the view that the peer feedback instruction and peer feedback rating leads to peer feedback dialogues that, in turn, promote deep learning in SPOCs. Results also indicate that this method activates the student mechanisms as expected. These mechanisms are of importance for the promotion of deep learning. We will discuss the main findings of our study through both research questions.

## 5.1. To what extent does the reinforcement of the feedback dialogue in SPOCs lead to the intended deep learning outcome?

### 5.1.1. Dialogic peer feedback

Students experienced the feedback dialogue process in the three steps: feedback instruction, feedback assignment and rating, and feedback discussion. Results indicate that the combination of feedback instruction and knowing that their feedback would be rated led students to pay close attention to carefully formulating feedback, aiming for deep learning. Moreover, rating of feedback seems to encourage students to learn even deeper. Rating forces students to critically approach the feedback received and to carefully reflect on what they have learned and how this relates to the feedback they received. By reflecting on the feedback received, students strengthen their understanding and, therefore, are in a better position to improve their performance and deepen their learning while developing self-reflection skills (Trevelyan & Wilson, 2012). And reflection may elicit deep learning, as Nicol (2009) and Moon (2013), among others, have stated.

Subsequently, this study shows the added value of feedback given by peers instead of instructors. Based on the interviews and previous literature (Ertmer et al., 2007; Gielen, Tops, Dochy, Onghena, & Smeets, 2007; Paulus, 1999; van den Boom, Paas, & van Merriënboer, 2007; Yang, Badger, & Yu, 2006) students may share a common belief that instructors provide superior feedback. Remarkably, in line with Yang et al. (2006) and Gielen et al. (2010), peer feedback seems to provoke deep learning precisely because of the fact that the feedback is given by a peer. As students do not trust their peers' expertise blindly, they keep questioning each other's feedback more than they would when feedback is provided by an instructor. Based on the interviews, they put more effort into processing the feedback and deciding to what extent they agree with the feedback received and whether the feedback changes their view on the assignment they submitted. Therefore, we indicate that the value of peer feedback results predominantly from the peer dialogue it triggers, rather than from the feedback itself.

Nevertheless, contrary to our expectations, the results of this study do not support the value of a continuing dialogue between the feedback provider and the feedback receiver during the last step of the feedback intervention, which is 'peer feedback discussion.' In this study, students made little use of the feedback discussion to continue their dialogue after the response of the feedback receiver. Results show that it is important to give the discussion between peers an appropriate and user-friendly place within the virtual learning environment so as to integrate the discussion in the feedback dialogue and to facilitate the use.

### 5.1.2. Deep learning outcome

The extent to which deep learning has been achieved is measured through 1) critical thinking; 2) integrating what the student is learning with what he or she already knows; and 3) creating new connections and concepts. Results from questionnaires indicate that a perception of achieved deep learning of respectively 94%, 90%, and 86% for each of the 3 aforementioned elements. If at least one out of these three had been achieved, it was always 'critical thinking'. This implies that 'critical thinking' is conditional for 'connecting concepts' and 'creating new concepts.' Fewer occurrences of the last two can also be caused by the fact that they may be more difficult to achieve. More research is required to find out which online interventions are needed to trigger 'connecting concepts' and 'creating new concepts' even more.

This study further demonstrated that students may consider the feedback useful without finding it stimulating for a deep learning approach, which implies that they are well able to distinguish the difference between a surface learning approach and a deep learning approach.

### 5.1.3. Peer feedback features

The results obtained provided new information about the features of peer feedback that promote deep learning. Features such as explanations about why an answer may (not) be right and suggestions for improvement are in line with previous studies about good quality feedback (e.g. Gielen et al., 2010; Patchan, Schunn, & Correnti, 2016), but add the specific aim of deep learning. To the best of our knowledge, the feature of adding one's own perspective, such as the feedback provider telling the feedback receiver a personal opinion on the assignment submitted, has not been found before with regard to deep learning. It causes students to reflect and gain new insights, which contributes to elements of deep learning. Subsequently, adding a theoretical source remarkably appears to have the opposite effect, since low rated feedback has a relatively high score (89%) in contrast to high rated feedback (14%). To the best of our knowledge, this effect of adding a theoretical source to peer feedback has not been found earlier. Adding a theoretical source may be considered as a specific type of argumentation, in which the peer points out course material, often a scientific article, to support the peer feedback. The result may indicate that students, probably unconsciously, trust the theoretical source blindly. This may cause feedback receivers to choose a surface learning approach. This implies that they stop further thinking about it, but instead go on with the next learning activity. On the contrary, explanations from peers do promote deep learning because the student questions the feedback, which causes reflection on what is learned.

## 5.2. To what extent are the mechanisms in SPOCs triggered by reinforcement of the feedback dialogue?

This study has shed more light on the student mechanisms that trigger a deep learning approach. By acknowledging and understanding the student mechanisms, we may be in a better position to recommend appropriate interventions and improve deep learning outcomes. Previous research (Author et al, 2018a) shows that if the mechanisms 'Feeling personally committed', 'Asking and providing relevant feedback,' and 'Understanding one's own learning process' are triggered, deep learning will be achieved. Results show that the peer feedback dialogue is able to trigger the first three mechanisms. The mechanism 'Understanding one's own learning process' hasn't been mentioned often. A possible explanation may be that the specific context of SPOCs, in which students follow a

predetermined learning path, may trigger this mechanism to a lesser extent than a self-paced course with a self-chosen learning path. Another explanation may be that this mechanism requires adjustments to the feedback dialogue, for example by extending it.

We had expected to find the mechanism ‘back and forth probing’ in the last step of the intervention more frequently than we actually did. Instead, this mechanism has been triggered mostly in step 2 during the group assignments. Group assignments include many interactions between peers, which often elicit fast back and forth probing. This is in line with studies on computer-supported collaborative learning (CSCL environments) that indicate that group assignments foster collaboration and knowledge construction between students (e.g. Noroozi, Weinberger, Biemans, Mulder, & Chizari, 2013). The collaboration between students elicits back and forth probing, which leads to deep learning.

The mechanisms in this study describe what needs to be set in motion in the students in order to achieve deep learning. Findings confirm our previous study (Filius et al., 2018b) in which the mechanisms are considered as a deepening of the Online Learning Interaction Model (Ke & Xie, 2009). In this model the different types of interaction that are needed for deep learning are addressed. These different types are social, knowledge construction, and learning regulation. Findings confirm our previous study (Filius et al., 2018b) that the student mechanism ‘feeling personally committed’ may be a type of the ‘social’ interaction, the mechanisms ‘probing back and forth’ and ‘understanding one’s own learning process’ may be a type of ‘knowledge construction’ and the mechanism ‘asking and providing relevant feedback,’ may be a type of the ‘learning regulation’.

### 5.3. Practical implications

Our findings provided more insights into precisely how the mechanisms work and how instructors can take them into account when designing and implementing feedback interventions. It also allows instructors and designers of online education guidelines to take into account when they want to promote deep learning in SPOCs. It gives them information about, for example, which student mechanisms you should try to provoke when designing assignments in SPOCs. This study also gives several pieces of practical advice for designing and implementing the feedback dialogue. An example is that both the assignment and the instruction for the feedback provider should be aimed at reflection and provoking discussion instead of finding the right answers. Another example is that group assignments seem to elicit the student mechanisms ‘Feeling personally committed’ and ‘Probing back and forth’ easier than the individual assignments. Instructors may want to take this into consideration when designing a new course.

In this study, an extensive feedback instruction for students was part of the intervention. The quality of the instruction can affect the quality of the peer feedback and therefore indirectly also the extent to which deep learning occurred. We would therefore like to advise instructors to always pay sufficient attention to the instructions as part of the feedback dialogue, preferably by means of a long term learning pathway, allowing feedback a structural place in the curriculum. Our instruction material is available on request.

In order to monitor the quality of the peer feedback and meet the wish of students for instructor feedback, we suggest adding the following step to the intervention. Beyond instructors’ moderation of the feedback, it could also be helpful if the instructor would randomly select and discuss a small percentage of the feedback provided. This step may also contribute to the improvement of the students’ feedback skills. Another suggestion to monitor the quality may be to add one more feedback provider for each assignment.

It remains a challenge to find the right balance between providing flexibility in study times on the one hand, and on the other, providing the dialogue that deep learning requires. After all, dialogue demands fixed time slots, while flexibility is often the reason why students choose an online medium. However, the results of this study give instructors more insight into how to meet that challenge and which interventions are effective. Furthermore, this study demonstrated that the interventions did not increase the workload of instructors when the student number increased and thus the number of SPOCs increased.

To encourage students to provide dialogic peer feedback aimed at deep learning initially calls for a time investment: time that is not spent on teaching content knowledge. We suggest that there is a turning point. From the moment of the turning point, instructors will benefit and capitalize on peer feedback as an instructional strategy. Hence, dialogic peer feedback in SPOCs may indeed cater to the instructor’s need for a more scalable method and to the student’s need for personalized feedback that promotes deep learning.

### 5.4. Future research

The peer feedback dialogue was introduced as a scalable way to promote deep learning. This study shows the added value of the role of the peer in providing feedback, the importance of instruction, and the benefits of rating peer feedback – all to promote deep learning. The peer feedback dialogue has been shown to be a feasible and promising way to let students discuss their assignments and aim for deep learning. However, there may be the potential to let the back and forth probing take longer to further strengthen the feedback dialogue. Further studies may take the practical reasons mentioned in our results into account to investigate whether further back and forth probing promotes deep learning even better, for example by adjusting the assignment instructions. Based on the findings in this study, group assignments with peer feedback may also have potential for promoting deep learning.

Further on, this study is partly based on self-reported data. Using self-reported data are prone to biases (e.g., social desirability bias, recall biases, and non-representativeness), which may have affected the external validity of the findings. Moreover, self-report questionnaire methodologies assume that respondents are aware of and willing to report their behavior (e.g. Fan et al., 2006). Some of the risks have been mitigated to prompt and probe during the in-depth interviews. For future research, we think the development of more direct and possibly objective methods for measuring deep learning would be valuable.

Subsequently, since further development and evaluation is needed, it will be useful to implement and evaluate the feedback dialogue at a large scale so that results can be generalized to a larger group. And beyond the current frequently used formats of asynchronous written peer feedback, we need to find out which other formats (synchronous, audio recordings, video recordings, and

others) promote deep learning, as well as to what extent and why they are successful in doing so. As higher education is increasingly provided via online channels, more research is needed to advance our knowledge of scalable ways to promote deep learning in online education.

### 5.5. Conclusion

This study showed how the combination of training and rating of feedback by students leads to carefully formulated feedback, critically approaching the feedback received, and to reflection, which in turn promotes deep learning. Also, as students don't trust each other's expertise blindly, they question peer feedback more than they would question instructor feedback, which also promotes deep learning. The findings of this study will serve a pragmatic and beneficial function in understanding how to promote deep learning with dialogic peer feedback as a scalable way in service of both instructors and online students.

### Endnote

This article is part of continuing study in the Netherlands concerning international students, where the focus is on developing evidence for online feedback to promote deep learning. This will enable us to increase our understanding of what is actually happening in SPOCs when students provide and receive feedback to promote deep learning.

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### Appendix 1. Interview questionnaire for students

1. Please describe to what extent this course promoted deep learning for you and why?
  - Did you have enough prior knowledge to participate in this course? Why do you think so? Could you give an example? Did you ever feel like you didn't have enough prior knowledge? What exactly happened?
  - Did you connect new knowledge with what you already knew? Can you give an example? What exactly happened?
  - Did you learn new concepts? Which one(s)? What exactly happened?
  - Did you see new relations? When? Which one(s)? What exactly happened?
  - Did the course stimulate you to critical think? How?
2. Regarding the extent to which deep learning was promoted, what was the role of feedback? (peer feedback, formative assessments en instructor feedback)
  - How?
  - What feedback did the instructor(s) give?
  - What feedback did the students give (to each other)?
  - What feedback did you receive yourself? (self assessment/multiple choice test – and the 'reflection' learning activities)
3. How did you experience the feedback?
  - Did you understand and accept the feedback that you received?
  - To what extent did the feedback stimulate you to deep learning? Why?
4. Did you provide feedback yourself?
  - How did this go? Why?
  - What were your aims with the feedback?
  - Do you think that the feedback receiver understood and accepted the feedback? Why do you think so, what happened?
  - What did the feedback receiver do with the feedback? How do you know?
  - How did the feedback receiver value the feedback? How do you know?
  - Do you think that the feedback promoted deep learning? Why?
5. How can we use feedback to promote deep learning at online education?
  - How can we ensure that new knowledge in this course is being connected to what the student already knows?
  - And that new concepts are being learned?
  - And that new connections are being created?
  - And that the course promotes critical thinking? How?
  - What causes, in your opinion, that deep learning is or is not reached? Why is that so, do you think?
  - Did this work out well in this specific course, according to you? Why do you (not) think so?
  - What do you think is most important to the feedback that students received in this course? What problems did you experience, what do you think is difficult?
  - Have you got any other ideas about what could happen to reach deep learning through feedback at online education?
  - Suppose that you should formulate an advice about providing feedback tot promote deep learning in this specific course; what advice would that be?
6. Closure

- Are there any questions that you expected, but that I didn't ask?
- What else would you like to say about feedback or deep learning?

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