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Supporting Pre-Service Teachers' Evidence-Informed Reasoning Through Peer-Feedback: Effects of Feedback Provision and Feedback Integration Scaffolds

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Abstract: Having pre-service teachers provide and receive peer-feedback on their analyses of authentic classroom problems may help them acquire evidence-informed reasoning skills. However, without instructional guidance, students may struggle to provide high-quality feedback and to integrate multiple feedback messages. We investigated the impact of feedback provision and feedback integration scaffolds and their combination on (a) pre-service teachers' improvement from draft to revision, and (b) their acquisition of evidence-informed reasoning skills. $N = 254$ pre-service teachers analyzed a classroom case vignette by aid of educational theories, provided feedback to two peers, and revised their initial analyses based on the feedback they received. Neither the feedback provision scaffold nor the feedback integration scaffold had a significant effect on the improvement. For the acquisition of evidence-informed reasoning skills, there was a significant negative interaction effect. This suggests that the scaffolds need to be better synchronized so that their combination yields additional effects.

Aims of the study

Teachers are increasingly required to solve teaching problems in accordance with educational theories and findings (Dekker & Meeter, 2022). Yet, studies revealed that pre-service teachers often struggle with evidence-informed reasoning when given the task to solve authentic classroom problems (Kiemer & Kollar, 2021). One possible way to support pre-service teachers' acquisition of evidence-informed reasoning skills might be to engage them in mutual peer-feedback on their analyses of authentic classroom cases. By providing feedback to each other, students are actively involved in knowledge construction processes (e.g., Double et al., 2020). Further, integrating the feedback they receive from their peers into their own analysis can be considered an important prerequisite for knowledge and skill acquisition (Chi & Wylie, 2014). Nonetheless, prior studies demonstrated that pre-service teachers require support in delivering high-quality feedback and integrating multiple feedback messages. The current study looks into ways how to best instructionally scaffold the peer-feedback process, with a specific emphasis on the effects of a feedback provision scaffold and a feedback integration scaffold on the extent to which pre-service teachers increase the quality of their initial analyses, and on the acquisition of evidence-informed reasoning skills.

The peer-feedback process and its potential for learning

Peer-feedback is a reciprocal process in which learners evaluate each other's performance (e.g., Hattie & Timperley, 2007). It includes four phases: First, in the *task performance phase*, the learners, usually working individually, carry out an assignment focused on a particular subject. Subsequently, in the *feedback provision phase*, learner A assesses the quality of B's performance, and vice versa. The ensuing *feedback reception phase* encompasses both learners receiving and assimilating feedback from each other. Finally, in the *revision phase*, the learners revise their task solutions based on the feedback they have received (Kollar & Fischer, 2010).

The potential of peer-feedback to support learning lies in the fact that students take on an active role in evaluating, assessing, and monitoring their own learning (e.g., Double et al., 2020). In fact, empirical research has shown that peer-feedback may be beneficial for learning, both for the feedback provider and the feedback recipient (Li et al., 2020). Through feedback provision, students assess their own work by comparing it to their peers' and gain insights into their performance. Upon feedback reception, students explore, compare, and weigh alternative task approaches and develop skills in handling various feedback types, enabling them to extract the maximum benefit from it (Nicol et al., 2014). Yet, studies that look at the effects of peer-feedback in the context of pre-service teachers' evidence-informed reasoning are rare.

Augmenting peer-feedback with a feedback provision scaffold and a feedback integration scaffold

Even though peer-feedback has a strong potential to support student learning, this potential is not always used. Students often have difficulty to (a) provide high-quality feedback and to (b) process the feedback they receive effectively (e.g., Carless & Boud, 2018). With respect to (a), high-quality feedback should include information that prompts the recipient to recall the task (feed up), assess their performance in relation to it (feed back), and provide recommendations for improvement (feed forward, Hattie & Timperley, 2007). However, without guidance, students rarely provide such high-quality feedback (Alemdag & Yildirim, 2022). The same is true for (b) processing received feedback effectively (e.g., Lui & Andrade, 2022), especially when multiple feedback messages need to be integrated with one another. In other words, students often struggle when they receive feedback on their initial task solutions from more than one peer. In this context, integration is defined as the active involvement with multiple texts in which significant content is interconnected to serve as a foundation for revision (e.g., Barzilai et al., 2018). To benefit from such multiple feedback messages, however, mindful processing by the recipient is necessary, but rarely achieved by learners (e.g., Berndt et al., 2018). To promote pre-service teachers' evidence-informed reasoning, both providing and receiving feedback should thus be augmented with appropriate scaffolds, such as rubrics or prompts (e.g., Prins et al., 2005). Although there is a lack of research on the use of peer-feedback to promote evidence-informed reasoning, studies in other contexts, such as self-regulated coherence construction, indicated that a combination of prompts and worked examples holds significant promise for feedback provision (e.g., Graichen et al., 2019). However, to the best of our knowledge, no studies exist on how appropriate scaffolds should be designed for the integration of multiple feedback messages in order to achieve positive effects on performance improvement in the context of analyzing authentic teaching cases and on pre-service teachers' acquisition of evidence-informed reasoning skills.

Research questions and hypotheses

This study examines the effects of feedback provision and feedback integration scaffolds and their combination on pre-service teachers' (a) improvement of their analyses of authentic teaching problems from initial draft to revision, and (b) their acquisition of evidence-informed reasoning skills. We hypothesized that both kinds of scaffolds would lead to an improvement from draft to revision (H1), and an improved acquisition of evidence-informed reasoning skills (H2).

Methods

Sample and design

To test our hypotheses, we ran an experimental study with a 2x2 factorial between-subjects design with the independent variables "feedback provision scaffold" (available vs. not available) and "feedback integration scaffold" (available vs. not available). $N = 254$ pre-service teachers participated in the context of a regular higher education course, with a mean age of $M = 22.56$ ($SD = 4.30$) and 77.95% of them being female on average in the middle of their studies ($M = 4.61$, $SD = 1.20$). The study was conducted using an online tool that can be used to structure the peer feedback process.

Procedure

After a pretest that measured demographic variables, the learning phase corresponded to the four phases of the peer-feedback process described above (task performance phase, feedback provision phase, feedback reception phase, revision phase). The students had one week to complete each phase. Students were asked to individually analyze a written case vignette describing a problematic classroom situation. Each case vignette included six problems, and participants were asked to structure their analysis of each of these problems in five steps: problem identification, problem description, problem explanation, goal setting, and deciding for action (see Greisel et al., 2022). To support the analysis, they were given a summary of two educational theories and related empirical evidence, namely (a) Cognitive Load Theory (Sweller, 1999) and (b) the ICAP model (Chi & Wylie, 2014). Then, the students provided feedback on the problem analyses of two peers. After having received feedback from two peers, the students were supposed to integrate the two feedback messages for the revision of their original analysis. One week after the revision, students completed a posttest to measure their evidence-informed reasoning skills.

Independent variables

During the *feedback provision* phase, we varied whether or not students received three kinds of prompts and a specific example of how these prompts can be used in practice: to (a) explain the assignment to their classmates once more (feed up, e.g.: "Recall the task and describe it briefly in your own words."), to (b) assess the degree to

which their peers engaged in constructive and critical problem-solving (feed back, e.g.: "Explain how the fellow student completed the task."), and to (c) offer suggestions for revision (feed forward, e.g.: "Finally, make specific suggestions for how your peer can improve his or her problem analysis."). Regarding *feedback reception*, students received either prompts and an example that explicitly guided them in integrating the feedback they received from the two peers, or nonspecific prompts, depending on the condition. The scaffold acted as a systematic approach to integrating the feedback messages. First, students were directed to read both feedback messages and then compare them. Next, they were asked to highlight points of agreement in green, complementary points in yellow and points of contradiction in red. In the third step, students were tasked with revising their draft using the feedback messages and indicating the changes using the same color-coded system from the previous step.

Instruments

To evaluate the *quality of the initial draft* and the *revision*, we used a rubric with four levels ranging from 0 (poor quality) to 3 (high quality). Two raters, unaware of the conditions, coded 10 % of the data independently. They achieved excellent interrater agreement (Gwet's $AC1$ = .99). Subsequently, the remaining 90 % of the data was evenly divided between the two coders. The difference scores between the quality of the draft and the quality of the revision were used as an indicator for improvement.

To measure *skills in evidence-informed reasoning*, we presented students three exemplary analyses of a new case vignette describing problematic classroom situations according to the Cognitive Load Theory (Sweller, 1999) and the ICAP-Model (Chi & Wiley, 2014). These analyses varied concerning the framework used for evidence-informed problem analysis. In the best problem analysis, all five steps were executed, while in the moderate or worst problem analyses, steps were either combined or disregarded entirely. The students had the task to sort the three analyses from best to worst.

Results

We fitted two linear models to predict the improvement from initial draft to revision and to predict the acquisition of evidence-informed reasoning skills, using R version 4.2.2.

The results revealed no significant effects for *the improvement from initial draft to revision*, neither for the feedback provision scaffold (b = .07, p = .58) nor for the feedback integration scaffold (b = .14, p = .22). Furthermore, the interaction effect was not significant either (b = -.27, p = .13).

For the *acquisition of evidence-informed reasoning skills* (H2), neither main effects of the feedback provision scaffold (b = .17, p = .12) nor of the feedback integration scaffold (b = .17, p = .06) were found. However, there was a significant interaction effect (b = -.38, p = .004): the feedback provision scaffold only had a favorable impact when no additional feedback integration scaffold was presented and vice versa.

Discussion

Contrary to our expectations, we found no effects for the improvement from initial draft to revision, neither for the feedback provision scaffold nor for the feedback integration scaffold nor for their interaction. This is surprising, since theoretically it could be expected that students would improve their performance through peer-feedback as they should actively engage with the material and read their peers' analyses, which should in turn provide them with different perspectives that they have to reconcile with their own solution (e.g., Nicol et al., 2014). Thus, it seems that at least when it comes to help pre-service teachers improve upon their evidence-informed analyses of authentic classroom cases, scaffolding approaches that have been shown beneficial in other settings cannot simply be transferred to this context. Future research is necessary to figure out how to best design the peer-feedback process to actually achieve such improvements.

The negative interaction effect of the two scaffolds on students' acquisition of evidence-informed reasoning skills indicated that the scaffolds work on their own, but not in combination. One explanation might be the different focus of the scaffolds: While the feedback provision scaffold referred to a distinct structure of how to provide feedback, the integration scaffold was concerned with connecting the feedback messages to one another, regardless of the structure of the feedback. As a result, the feedback integration scaffold might have diverted students' attention away from the required analysis method. It might thus be promising to look into how feedback provision scaffolds on the one hand and feedback integration scaffolds on the other can be better synchronized to avoid mutual interference effects (Prins et al., 2005). This should be investigated in future studies.

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