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Promoting learning by leveraging the collaborative nature of formative peer assessment with instructional scaffolds

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Abstract Over the past two decades, formative peer assessment has become a popular instructional approach. Initially, it was more readily applied in higher education but has since expanded to other educational levels, including primary and secondary education. The popularity is understandable given the increased amount of feedback by multiple peers and enhanced awareness of performance criteria. Although it is increasingly acknowledged by the research community that formative peer assessment is inherently a social endeavour, the collaborative nature is simultaneously the least-explored mechanism. The contributions in this special issue address this gap conceptualising peer assessment and peer feedback as both an individual and a collaborative learning practice. Furthermore, we highlight core learning conditions: learner characteristics, domain and task characteristics, and, finally, instructional scaffolds.

Keywords Peer assessment · Peer feedback · (Computer-supported) collaborative learning (CS) CL · Inquiry learning

Introduction

Amid the rise of formative assessment in education, peer assessment has become a popular instructional approach to enhance student involvement in assessment—yet, its popularity did not develop overnight. Over the past two decades, research studies gradually accumulated, including 20 review studies covering topics such as the design and implementation of peer

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assessment practices (Gielen et al. 2011; Luxton-Reilly 2009; Topping 1998; Strijbos et al. 2009; Van Gennip et al. 2009; Van den Berg et al. 2006), reliability and validity of peer assessment (Falchikov and Goldfinch 2000; Li et al. 2016; Topping 1998, 2003), quality criteria for peer assessment practices (Ploegh et al. 2010; Tillema et al. 2011), social and interpersonal variables (Strijbos et al. 2009; Van Gennip et al. 2009; Panadero 2016), and how research methodology and instructional conditions relate to peer assessment outcomes (Ashenafi 2017; Hoogeveen and Van Gelderen 2013; Sluijsmans et al. 1999; Van Popta et al. 2017; Van Zundert et al. 2010).

Formative peer assessment is particularly appealing because it stimulates the learning of higher-order skills such as sharing responsibility, reflection, discussion, and collaboration (Panadero 2016; Strijbos and Sluijsmans 2010; Strijbos et al. 2009; Van Gennip et al. 2009; Van Popta et al. 2017; Van Zundert et al. 2010). However, parallel to their increased popularity, formative peer assessment practices have also become more diverse (Gielen et al. 2011; Strijbos et al. 2009; Van den Berg et al. 2006; Van Gennip et al. 2009). Whereas, peer assessment was initially predominantly used in higher education, its use in primary, secondary, and vocational education has expanded. Furthermore, from an initial predominant focus on the domain of writing (academic writing, English as a foreign or second language) and activities such as student presentations, other domains have more recently been added such as science and mathematics. Finally, the emphasis on formative peer assessment broadened the scope of peer feedback—i.e. written or oral comments and replies, instead of or in addition to scoring—thus highlighting communicative and interactive processes, and thereby the collaborative nature of peer assessment.

With increased popularity, comes responsibility to improve our understanding of the core mechanisms of formative peer assessment in an effort to further optimise instructional practices and student learning. In line with the need for functional, methodological, and conceptual development as argued by Strijbos and Sluijsmans (2010), this special issue addresses the need for methodological development by exploring learning benefits using rigorous research designs, functional development by emphasising the formative purpose of peer assessment and peer feedback, i.e. learning benefits for the assessor and/or the assessee, and finally, conceptual development by approaching formative peer assessment and peer feedback as an inherently social learning practice. This special issue not only addresses these three needs, but extends the conceptual development by paying attention to the role of tasks and domains.

Conceptualising peer assessment and peer feedback as an interpersonal and collaborative learning practice

Formative peer assessment and peer feedback are increasingly approached as an interpersonal and collaborative learning practice (Li et al. 2016; Kollar and Fischer 2010; Panadero 2016; Strijbos et al. 2009; Van Gennip et al. 2009; Van Popta et al. 2017). The collaborative nature was acknowledged early-on in research on writing instruction and English as a foreign or second language—reflected in the use of ‘peer response’ as the overarching term (Hoogeveen and Van Gelderen 2013). Saunders (1989) distinguished five activities in the context of collaborative writing amongst which the ‘co-responding interactive structure’ described as a “two-way dialogue between writers and readers (...) each student receives feedback about his or her piece of writing, and each student provides feedback about the writing of each member

in the group.” (p. 104). Likewise, the collaborative nature was noted early-on in collaborative learning research by Johnson and Johnson (1994) as peer assessment can enhance (a) positive interdependence by confirming and/or enabling students’ (re)alignment with the shared goal/product of collaborative learning and (b) individual accountability by making students’ low, average, or high contribution to the collaboration visible. Although collaborative learning research recently ‘rediscovered’ peer assessment as a method to assess collaborative learning (De Wever et al. 2011; Gillies 2007; Strijbos 2011; Strijbos et al. 2009; Van Aalst 2013), it has been studied as ‘peer assessment of group work’ in assessment research since the early 1990s (Lejk et al. 1996; Strijbos 2016). Fortunately, research on formative peer assessment and peer feedback adopted a more integral approach over the past decade, combining research on writing instruction, peer assessment, and collaborative learning (Li et al. 2016; Panadero 2016; Strijbos et al. 2009; Van Gennip et al. 2009; Van Popta et al. 2017). In this special issue, formative peer assessment and peer feedback is therefore conceptualised as an interpersonal and collaborative learning practice.

Learning conditions of peer assessment and peer feedback as an interpersonal and collaborative practice

Peer assessment and peer feedback as an interpersonal and collaborative practice refers to a process in which one or multiple assessors (individual student or group) provide quantitative (scores or grades) and/or qualitative (written and/or oral comments) feedback on the product of one or multiple assesseees (individual student or group), who subsequently interprets the feedback and applies it (partially or fully) to revise the product and/or interacts with the assessor to clarify their interpretation and/or justify the extent to which it was applied. However, conceptualising formative peer assessment and peer feedback as an interpersonal and collaborative practice also highlights the need to investigate learning conditions—in particular those of interpersonal and collaborative nature—that foster or hinder learning. Hence, this special issue will specifically address the following learning conditions: (a) learner characteristics, (b) domain and task characteristics, and (c) instructional scaffolds.

Learner characteristics of students in their role of assessor and/or assessee can impact interpersonal processes such as trust. Students can be hesitant to accept formative peer assessment and peer feedback to improve their learning products due to uncertainty about its accuracy and proficiency of the provider, or to provide formative peer assessment and peer feedback to a peer due to uncertainty about their own proficiency (Panadero 2016; Strijbos et al. 2009; Van Gennip et al. 2009). This ‘proficiency’ not only refers to the peer assessment/peer feedback skill, but also to the domain and task (Van Zundert et al. 2010).

Task and domain characteristics have received more attention in recent years. Although a substantive number of studies have been conducted in the domain of languages (e.g. writing instruction or English as a foreign or second language) or used the ‘presentation’ as the learning task, the diversification of peer-assessment practices concurrently expanded across domains (e.g. mathematics, science, medicine) and types of learning tasks (e.g. proof construction, modelling, diagnosis), underlining the significance of domain-specific knowledge and task complexity. This special issue will focus on the diversification by taking into account various domains and tasks.

Finally, instructional scaffolds—most notably collaboration scripts—have been identified as essential for productive collaborative learning. Likewise, such instructional scaffolds—e.g. rubrics, prompts, and/or scripts for the role of assessor and assessee (e.g. Gielen et al. 2010;

Gielen and De Wever 2015; Panadero et al. 2013; Rotsaert et al. *in press*)—can foster productive formative peer assessment and peer feedback and thus increase learning benefits. Especially, instructional scaffolds that facilitate self-regulation in service of peer assessment and peer feedback—for example by helping the learner to clarify learning goals, understand the purpose of formative peer assessment and peer feedback, or to reflect on provision and reception—have strong potential for increasing learning benefits (Panadero et al. 2016).

Overview of the contributions to this special issue

The contributions in this special issue will tackle open issues regarding formative peer assessment and peer feedback as an interpersonal and collaborative practice—in particular—the impact of core instructional conditions. The first four contributions focus on learner and/or domain and task characteristics, whereas the last four contributions focus on the impact of instructional scaffolds.

The contribution by Alqassab et al. (2018) focused on peer-feedback beliefs and peer-feedback provision skills. Preservice mathematics teachers were trained to provide peer feedback on different levels (i.e. task, process, and self-regulation) on geometric construction tasks and were scaffolded with worked examples, feedback provision prompts, and evaluation rubrics during the training. A quasi-experimental mixed design was used with domain knowledge as between-subjects factor and measurement occasion as within-subject factor. Peer-feedback provision skills and their beliefs about peer-feedback provision were measured before and after the training. The results show that students with high and medium domain knowledge provided more peer feedback at the self-regulation level, whereas those low in domain knowledge provided more peer feedback at the task level after the training. Beliefs about peer-feedback provision became less positive after the training, regardless of students' domain knowledge.

The study by Berndt et al. (2018) investigated peer-feedback perceptions and peer-feedback application. In a controlled laboratory setting, psychology students were immersed in a fictitious peer-feedback scenario in the area of academic writing. In a 2×2 factorial design, peer-feedback content (concise general feedback vs. elaborated specific feedback) and competence of the sender (high vs. low) were varied. Eye tracking was applied to measure how written peer feedback was (re-)read, e.g. glance duration on exact words and sentences. Mindful cognitive processing was inferred from the relation between glance duration and (a) text-revision performance and (b) peer-feedback recall performance. The study shows that feedback by a high-competent peer was perceived as more adequate, and those who received elaborated specific feedback displayed more positive affect. Glance durations were negatively correlated to text-revision performance regardless of experimental condition, although peer-feedback recall showed that a basic amount of mindful cognitive processing occurred in all conditions.

The contribution by Tsivitanidou et al. (2018) examined reciprocal peer assessment. Upper secondary education students in a physics course completed hands-on experiments in a laboratory. In a within-group repeated measures design, students worked in dyads and were asked to model additive and subtractive colour mixing. Each dyad's model was individually assessed by both students of another dyad. Afterwards, each dyad discussed the peer assessments and revised their model. The results show that individual students were able to identify shortcomings in the assessee's model, justify their comments, and provide suggestions for improvement. Conversely, dyads actively filtered comments to determine which comments

would help them improve the model. Finally, model revision led to higher-quality models and reflected a better conceptual understanding of additive and subtractive colour mixing.

The study by Rotsaert et al. (2018) focused on peer-assessment conceptions and peer-feedback provision skills. Educational science students worked in small groups to design a workshop. In a with-in group repeated measures design, each group presented their workshop design in a plenary session and each design was assessed by all fellow peers; hence, all students provided multiple peer assessments. This peer feedback was then projected—anononymously in the first two sessions, non-anonymously in the last two sessions—followed by a teacher-guided discussion. The content analysis of peer feedback revealed that the quality increased in the anonymous phase and that over time, feedback in the consecutive non-anonymous sessions was of similar quality. Furthermore, the transition from anonymous to non-anonymous peer assessment neither hindered students' perceived growth in peer feedback skills, nor did it negatively impact their peer-assessment conceptions.

The contribution by Leenknecht and Prins (2018) examined the impact of student involvement in setting assessment criteria and standards on their appraisal of a peer's product and their peer-feedback provision style. Primary education students were required to create an informative brochure, informative about climate change and energy reduction. The students were randomly assigned to one of two conditions. In the experimental condition, the students first received a peer-feedback exemplar, followed by group discussion about appropriate assessment criteria and standards. In the control group, students provided peer feedback without such discussion. Appraisal was measured with a questionnaire and feedback style was determined by analysing students' written feedback using a person-oriented approach (cluster analysis). The results show that students in the experimental condition were three times more likely to employ an authoritative peer-feedback compared to the control group.

The study by Peters et al. (2018) also examined peer-feedback provision skills. Vocational education students in metal cutting mechanics created a technical plan for producing a metal piece with a Computer Numerical Control (CNC) machine. In a 2×2 factorial quasi-experimental design, all students first created their own plan. Next, they generated peer feedback (with or without a formative assessment script) on a fictitious erroneous peer plan prior to generating internal feedback on their own plan, or they only generated internal feedback on their own plan (with or without a formative assessment script). The results show that students with the script generated more comments on the peer plan, which were more sensitive in detecting errors and missing information and generated more suggestions for improvement. With respect to internal feedback generation, the results were mixed. Although the students with the script generated more comments and ignored fewer erroneous elements in their own plan, they neither detected more missing information nor generated more suggestions on how to improve it than students without the script.

The contribution by Voet et al. (2018) focused on peer-feedback requests and peer-feedback reception. Educational science students were asked to write a research abstract for an academic paper from which it had been removed. In a repeated measures 2×2 factorial design, instructional scaffolding of the peer-feedback process was varied by means of a feedback-request (with vs. without) and a content checklist explaining the assessment criteria (with vs. without). Students assessed the research abstract of one peer before and after the implementation of the instructional scaffolds. The results show that the

length of the peer-feedback message needs to be considered when studying the effects of instructional scaffolds for peer assessment. Feedback requests did not impact the raw number of elaborations, but the proportion of informative elaborations was significantly higher in conditions with a feedback request. This signals that a peer-feedback request stimulated students to write more focussed messages, but simultaneously this had no effect on the assessee's agreement with the peer feedback.

The study by Wichmann et al. (2018) examined peer-feedback-based text changes and revision skills. Educational science students were asked to write a short essay on how a mother can support their child's identity formation. The students were randomly assigned to one of two conditions. All students were informed that they received feedback by a 'peer', which was actually provided by trained tutors. Students in the experimental condition additionally received an instructional scaffold (sense-making support) to encourage them to reflect on their understanding of the feedback with the aim to foster uptake and revision skills. The results show that scaffolding improved feedback uptake, i.e. a student with sense-making support made fewer new errors and rejected more incorrect feedback comments. Students' revision skills only improved with regard to problem detection. Sense-making support was effective to some extent and partially fostered the benefits of peer feedback, but peer feedback alone might not be sufficient for improving revision skills.

Finally, the commentary by Deiglmayr (2018) summarises the strengths and weaknesses of each contribution in relation to four open issues: helpfulness of criteria, conceptualising mindful cognitive processing, performance improvement in the core task, and the collaborative nature of peer assessment. The commentary concludes by proposing three dimensions to describe the degree to which instructional scaffolds can invoke interactivity and dialogic formative peer assessment.

Conclusion

The contributions in this special issue are from researchers with predominantly a background in collaborative learning as well as researchers with predominantly a background in formative assessment. It is reassuring that over the past decade, we have moved from near mutual ignorance to closer acquaintance and in some cases, even full partnerships. The contributions in this special issue signify that both domains are essential to advance our understanding of formative peer assessment and key instructional conditions, promote learning by leveraging the collaborative nature of formative peer assessment with instructional scaffolds, and draw conclusions that help us to develop guidelines for teachers and practitioners.

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Current themes of research:

Assessment and feedback. Technology-enhanced learning (TEL). (Computer-supported) collaborative learning (CS)CL. Peer assessment. Peer feedback. Feedback dialogues. Communities of learners/communities of practice. Instructional design. Analysis methods for (CS)CL. Content analysis of discourse

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Current themes of research:

Peer assessment. Peer feedback. (Computer-Supported) Collaborative Learning (CS)CL. Inquiry learning

Most relevant publications in the field of Psychology of Education:

- Wichmann, A., & Timpe, S. (2015). Can dynamic visualizations with variable control enhance the acquisition of intuitive knowledge? *Journal of Science Education and Technology*, 24(5), 709–720. <https://doi.org/10.1007/s10956-015-9554-8>
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