Scaffolding the Peer-Feedback Process: A Meta-Analysis

Julia Hornstein, Melanie V. Keller, Martin Greisel, Markus Dresel, Ingo Kollar
julia.hornstein@uni-a.de, melanie.keller@uni-a.de, martin.greisel@uni-a.de, markus.dresel@uni-a.de,
ingo.kollar@uni-a.de
University of Augsburg

Abstract: Peer-feedback can be supported by formal or subject-matter-related scaffolds. However, it is unclear whether these scaffolds differ in their effects on process-related and outcome-related variables. In our meta-analysis including N=22 studies with N=2.473 learners, results show a statistically significant effect only for subject-matter-related scaffolds on process-related variables. The lack of further effects might represent a power problem, i.e., more research is necessary to judge the effectiveness of the different scaffolds on process and outcome-related variables.

Aims and theoretical background

Peer-feedback has been shown to be an effective approach to support student learning. Through peer-feedback, students actively participate in the learning process and thus can increase their own knowledge and skill acquisition (e.g., Double et al., 2020). Typically, peer-feedback involves four sequential processes (Kollar & Fischer, 2010): Task performance, feedback provision, feedback reception, and revision. In this paper, we focus on the phases of feedback provision and feedback reception. The current state of research shows that peer-feedback requires instructional support (e.g., Lui & Andrade, 2022). Based on prior research (e.g., Vogel et al., 2017), at least two types of scaffolds can be differentiated: formal scaffolds (e.g., prompts how to structure feedback provision or feedback reception) and subject-matter-related scaffolds (e.g., questions related to the specific content that is being learnt). These scaffolds come in different forms, such as preparatory activities (e.g., training prior to the actual peer-feedback exercise), rubrics (e.g., in the form of a rating scheme), sentence starters, questions, or as integrated scaffolds (as a combination of different scaffolds). Single studies show that all these scaffolds can have positive effects on different process-related (e.g., feedback quality) and outcome-related (e.g., performance) variables (Zheng et al., 2020). Yet, what is missing is a systematic comparison of the effectiveness of the different scaffolds on these different process and outcome variables. Such a comparison would hold a strong potential to inform practitioners on how to optimally support their students in the peer-feedback process.

Research questions

Against this background, we ask: What are the effects of (1) formal scaffolds and (2) subject-matter-related scaffolds during peer-feedback on (a) process-related variables and on (b) outcome-related variables?

Methods

We conducted a systematic literature search using multiple databases (Web of Science, Psyndex, Pubmed, ERIC, PsycArticles, Mendeley, PubPsych) to identify relevant studies. After excluding duplicates, non-experimental studies and studies not published in English, $N = 22$ studies comprising a total of $N = 2.473$ learners ($M_{Age} = 18.94$, $SD_{Age} = 2.59$) were included in the analyses. These studies were coded with respect to (1) the kinds of scaffolds they used (formal vs. subject-matter-related, Gwet's $AC1 = .89$) and (2) what type of dependent variables (process-related vs. outcome-related, Gwet's $AC1 = .82$) they contained. We conducted a multilevel meta-analysis with robust variance estimation in R [4.3.2] using the 'metafor' package [4.4-0] (Viechtbauer, 2010) and the 'robumeta' package [2.1] (Fisher & Tipton, 2015). We tested for publication bias using funnel plots, rank tests (Begg & Mazumdar, 1994), and regression tests (Egger et al., 1997).

Results

We found that most scaffolds aimed to support the feedback provision phase ($n = 18$), while only less than one fifth of the scaffolds aimed at supporting the feedback revision phase ($n = 5$). The results of the moderator analyses for the process-related variables show that only subject-matter-related scaffolds ($g = .38$, 95% CI [0.07, 0.68], $p < .05**$) had a significantly positive effect, but not the formal scaffolds ($g = .49$, 95% CI [-0.33, 1.30], $p = .187$). In contrast, there are no significant effects of the formal ($g = .36$, 95% CI [-0.13, 0.86], $p = .129$) and the subject-matter-related scaffolds ($g = .29$, 95% CI [-0.09, 0.67], $p = .116$) on outcome-related variables. The results regarding the tests for publication bias did not suggest a risk of publication bias.

Discussion

As the descriptive results showed, current research mainly focuses on the promotion of feedback provision, but studies that focus on the promotion of feedback reception are scarce. Thus, there is a need for further studies on scaffolding feedback reception, as this phase may involve a cluster of learning processes that are particularly important for knowledge and skill acquisition via peer-feedback (Carless & Boud, 2018; Lui & Andrade, 2022).

The descriptive results of the moderator analyses showed that both types of scaffolds have positive effects on both process-related and outcome-related variables, but only the effect of subject-matter-related scaffolds on process-related variables was statistically significant. This effect is to be expected, as scaffolds are used for precisely this purpose: to have a positive influence on the learning process. However, the about equally large effect of formal scaffolds on process-related variables was statistically not significant, as only fewer studies included formal than subject-matter-related scaffolds. Similarly, there are rather few studies that investigated the effects of scaffolds on learning outcomes. Therefore, also the lack of those effects might reflect a power problem. Yet, the somewhat smaller effect sizes (compared to the effects on learning processes) may suggest that the scaffolds utilized in peer-feedback might not always be powerful enough to also yield positive outcome effects.

In summary, research does not yet seem to allow to arrive at general advice how practitioners should design scaffolds to foster peer-feedback effectiveness. Ideally, the amount of studies would be large enough to allow for a more fine-grained differentiation of specific types of scaffolds (e.g., preparatory activities, rubrics, sentence starters, questions, integrated scaffolds) and dependent variables (e.g., feedback quality, learning achievement, writing performance) meta-analytically. However, due to a lack of studies, we cannot say yet whether a practitioner should address formal or subject-matter-related aspects of the feedback to improve the feedback process or the outcome, and, more specifically, which specific scaffolds work best for which dependent variable. Thus, more research on this issue is urgently needed.

References

Begg, C. B., & Mazumdar, M. (1994). Operating Characteristics of a Rank Correlation Test for Publication Bias. *Biometrics*, *50*(4), 1088. https://doi.org/10.2307/2533446

Carless, D., & Boud, D. (2018). The development of student feedback literacy: enabling uptake of feedback. *Assessment & Evaluation in Higher Education*, *43*(8), 1315–1325. https://doi.org/10.1080/02602938.2018.1463354

Double, K. S., McGrane, J. A., & Hopfenbeck, T. N. (2020). The Impact of Peer Assessment on Academic Performance: A Meta-analysis of Control Group Studies. *Educational Psychology Review*, *32*(2), 481–509. https://doi.org/10.1007/s10648-019-09510-3

Egger, M., Davey Smith, G., Schneider, M., & Minder, C. (1997). Bias in meta-analysis detected by a simple, graphical test. *BMJ (Clinical Research Ed.)*, *315*(7109), 629–634. https://doi.org/10.1136/bmj.315.7109.629

Fisher, Z., & Tipton, E. (2015). *robumeta: An R-package for robust variance estimation in meta-analysis*.

Kollar, I., & Fischer, F. (2010). Peer assessment as collaborative learning: A cognitive perspective. *Learning and Instruction*, *20*(4), 344–348. https://doi.org/10.1016/j.learninstruc.2009.08.005

Lui, A. M., & Andrade, H. L. (2022). The Next Black Box of Formative Assessment: A Model of the Internal Mechanisms of Feedback Processing. *Frontiers in Education*, *7*, Article 751548. https://doi.org/10.3389/feduc.2022.751548

Reiser, B. J. (2004). Scaffolding Complex Learning: The Mechanisms of Structuring and Problematizing Student Work. *Journal of the Learning Sciences*, *13*(3), 273–304. https://doi.org/10.1207/s15327809jls1303_2

Viechtbauer, W. (2010). Conducting Meta-Analyses in R with the metafor Package. *Journal of Statistical Software*, *36*(3), 1–48. https://doi.org/10.18637/jss.v036.i03

Vogel, F., Wecker, C., Kollar, I., & Fischer, F. (2017). Socio-Cognitive Scaffolding with Computer-Supported Collaboration Scripts: A Meta-Analysis. *Educational Psychology Review*, *29*(3), 477–511. https://doi.org/10.1007/s10648-016-9361-7

Zheng, L., Zhang, X., & Cui, P. (2020). The role of technology-facilitated peer assessment and supporting strategies: a meta-analysis. *Assessment & Evaluation in Higher Education*, *45*(3), 372–386. https://doi.org/10.1080/02602938.2019.1644603

Acknowledgments