Do students' beliefs and orientations toward peer feedback predict peer feedback quality and perceptions?

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A B S T R A C T

The effectiveness of peer feedback is likely to depend on beliefs and orientations toward peer feedback. Therefore, we investigate to what extent they predict (a) the quality of the feedback that students provide to their peers and (b) the perceived adequacy of the feedback they receive from their peers. $N = 254$ pre-service teachers reported their beliefs and orientations, provided feedback, and processed the feedback they received. Regression analyses showed that beliefs and orientations were not associated with the quality of the provided feedback and that valuation of peer feedback as important skill and receptivity significantly predicted perceived feedback adequacy. The lack of associations when providing feedback might indicate that peer feedback as instructional context can provide external scaffolding to an extent that almost levels individual differences in beliefs towards peer feedback providing. Our results imply that training and instruction should mainly focus on fostering motivation for feedback reception.

1. Problem statement

Peer feedback is not only economic in contrast to teacher feedback (Topping, 1998), but can also be effective in fostering learning processes and outcomes. It can foster academic performance compared to conditions without feedback and even teacher feedback. For example, in the meta-analysis by Double et al. (2020), peer feedback was superior to teacher feedback regarding its effects on learning outcomes ($g = 0.28$; for similar results, see Li et al., 2020). The superiority of peer compared to teacher feedback is likely due to the fact that peer feedback creates additional learning opportunities and elicits additional learning processes, as students not only *receive* but also *provide* feedback (Reinholz, 2016; van Popta et al., 2017). Students themselves also acknowledge this beneficial effect of providing feedback on their peers' task solutions (Ion et al., 2019). Overall, both its efficiency and effectiveness make peer feedback a widely used instructional method by teachers and lecturers.

However, the heterogeneity of effect sizes in the meta-analyses by Double et al. (2020) and Li et al. (2020) indicates that peer feedback is not beneficial for every student under all circumstances (Brooks et al.,

2019). For example, the quality of the feedback that students provide is not always as high as desired: Very often, it focuses on praise and neglects necessary criticism (Patchan et al., 2013; Patchan & Schunn, 2015), points only to very concrete, low-level prose mistakes, or is rather unspecific regarding what exact part of the peers' task solution is criticized, thereby making it difficult to implement the respective comment (Patchan et al., 2016). Furthermore, students often fail to implement the feedback they receive from their peers, as this implementation process is a complex perception and processing task (Winstone, Nash, Parker, et al., 2017). For example, as was shown in a study by Jurkowski (2018), even when peer feedback uptake is supported by question prompts, students still only used about 50 % of correct comments in their revisions.

Whether students encounter these problems or, to the contrary, benefit from peer feedback, should, at least partly, depend on students' individual motivational prerequisites. Current theoretical models of peer feedback indeed regard learners' individual motivational prerequisites as potential moderators for the effectiveness of peer feedback (Carless & Boud, 2018; Lui & Andrade, 2022b; Narciss, 2008; Winstone, Nash, Parker, et al., 2017). For example, Lui and Andrade (2022b)

distinguish between beliefs about assessment (i.e., the valuation of peer feedback as instructional method; Huisman et al., 2020) and self-efficacy (i.e., the confidence in one's own ability to provide hiqh-quality feedback; Huisman et al., 2020) as potential moderators of feedback perception processes. However, whether beliefs such as beliefs about assessment and self-efficacy beliefs actually influence the effectiveness of peer feedback, has hardly been tested empirically so far (Leighton, 2019). Moreover, the models do not go much beyond mere lists of potentially relevant factors. Their specific contributions, that is, how their effects compare to each other and which specific processes they have an impact on, have neither been deeply elaborated nor systematically and empirically tested so far.

Therefore, we argue that it is crucial to better understand the role of students' individual motivational prerequisites within the peer feedback process, as practitioners need this knowledge in order to design instructional interventions accordingly. Teachers, for example, might wonder whether peer feedback as an instructional method is suitable for their students, whether their students feel responsible enough to provide valuable feedback to other students, whether students who doubt their own competency to provide useful feedback should be addressed differently than students who are more confident in their competency, whether they should mitigate critical feedback or check it before it is given back to the feedback recipient, and so on. All these questions focus on the extent to which peer feedback processes and outcomes are moderated by students' beliefs and orientations toward peer feedback. Therefore, this article investigates how motivationally relevant beliefs and orientations towards peer feedback impact outcomes in the peer feedback process, that is, (a) the quality of the feedback provided and (b) the perception of the feedback received.

2. Steps of the peer feedback process

To be able to develop later how beliefs and specific peer feedback processes may be related, we first describe a general peer feedback process. Peer feedback scenarios typically consist of four steps (see Fig. 1; Bauer et al., 2023; Reinholz, 2016): First, learners work on a task and submit an initial solution (task processing). For example, in a teacher education course, the instructor might ask their pre-service teacher students to analyze a case vignette of a lesson that describes how a teacher unsuccessfully copes with problematic situations (such as motivating their students or explaining difficult subject matter) and develop suggestions for alternative teacher actions. In the second step, students are asked to review the solutions of one or more peers, and, based on this review, produce a feedback message for each of the peers' initial task solutions that were assigned to them (feedback production). In our example, the students could be asked to review two of their peers' initial task solutions and comment on whether they correctly identified the main problems described in the case vignette and whether they used appropriate educational theories and evidence to explain them. Based on this review, students create a feedback message for each of the peers' initial task solutions. For example, one student might suggest that their peer should completely reformulate their initial analysis, while another student might identify and explain only a single logical flaw in the argument and inform their peer about it. Third, students process the feedback they receive (feedback processing). In our example, if a student receives the two feedback messages described above, they might evaluate the comment that their entire analysis should be reformulated as unfair and causing too much effort to deal with in their revision, but the more specific comment about the one logical flaw as useful. Fourth, they revise their initial solution based on the feedback (revision). The student in our example might then revise their initial argument, which was criticized in the second feedback message, but decide not to use the first feedback message in their revision. Finally, and optionally, the students evaluate the feedback process. Our student, for example, might be grateful for the one comment that helped them improve their argument, but they might also have learned that peers are not necessarily benevolent and that the quality of peer feedback can be questionable. After describing the general flow of a peer feedback process, we can now turn to the main outcome variables within this process, which will later be linked to beliefs and orientations toward peer feedback.

3. Feedback quality

The feedback messages that are exchanged between peers (see Fig. 1) play a central role in the peer feedback process (Panadero & Lipnevich, 2022). If they are of low quality, recipients cannot benefit from them as much as they could from high-quality feedback. Therefore, the quality of the feedback message created in the feedback production phase is an important dependent variable in research on peer feedback.

To describe what constitutes high-quality feedback, Hattie and Timperley (2007) proposed that feedback should answer three central questions (p. 87): "Where am I going" (feed up)? "How am I going" (feed back)? "Where to next" (feed forward)? In addition to these three questions, feedback should provide information not only about how well a task was performed (task level), but also about the processes involved in task processing (process level) and the self-regulation processes (self-regulation level) that are necessary or helpful to apply these task processes. Hattie and Timperley's findings show that students learn better when they receive feedback that meets these recommendations.

In terms of Narciss' feedback model (2008), Hattie and Timperley's dimensions refer to the content of feedback, where the task level could be equated with the evaluative component of feedback and the process and self-regulation levels with the informative component of feedback. Regarding peer feedback specifically, Patchan et al. (2016) found that peer feedback was effective when, as an evaluative component/at the task level, it contained comments on high-prose issues such as essay structure and on incorrect parts. As an informative component/at the process level, localizing where exactly the initial solution should be revised was most beneficial.

However, high-quality feedback does not guarantee successful learning on the part of the feedback receiver (Lui & Andrade, 2022b), as recipients could theoretically ignore even a correct, precise and very elaborate feedback if they think that the feedback is not adequate, that is, not fair, useful, or acceptable (Strijbos et al., 2021). Logically, students are unlikely to use feedback they regard as inadequate to revise their initial solution. Therefore, the implementation of feedback comments is likely to depend on how the feedback message is perceived. As a consequence, only considering the objective feedback quality is not enough to understand how students' individual motivational prerequisites are associated with their learning during the peer feedback process. In addition, research needs to examine how individual motivational prerequisites are associated with how adequate students subjectively perceive the feedback they receive.

4. On the role of individual motivational prerequisites during feedback provision and feedback reception

In the previous sections, we laid the foundation for connecting individual motivational prerequisites to specific processes in peer feedback by describing the general peer feedback process and central outcomes during this process. In the following, we describe in what parts of the process different beliefs and attitudes toward peer feedback influence both the quality of the feedback provided and the way it is perceived by the receiver.

As indicated above, several theoretical models on peer feedback assume that students' individual motivational prerequisites influence how students provide and process feedback. For example, Narciss' feedback model (Narciss, 2008) assumes that the way students process feedback is influenced by their motivation, their learning goals, prior knowledge, and meta-cognitive skills. In this regard, Winstone, Nash, Parker, et al. (2017, p. 25), for example, emphasize the importance of "being enthusiastic about and open to receiving performance information".
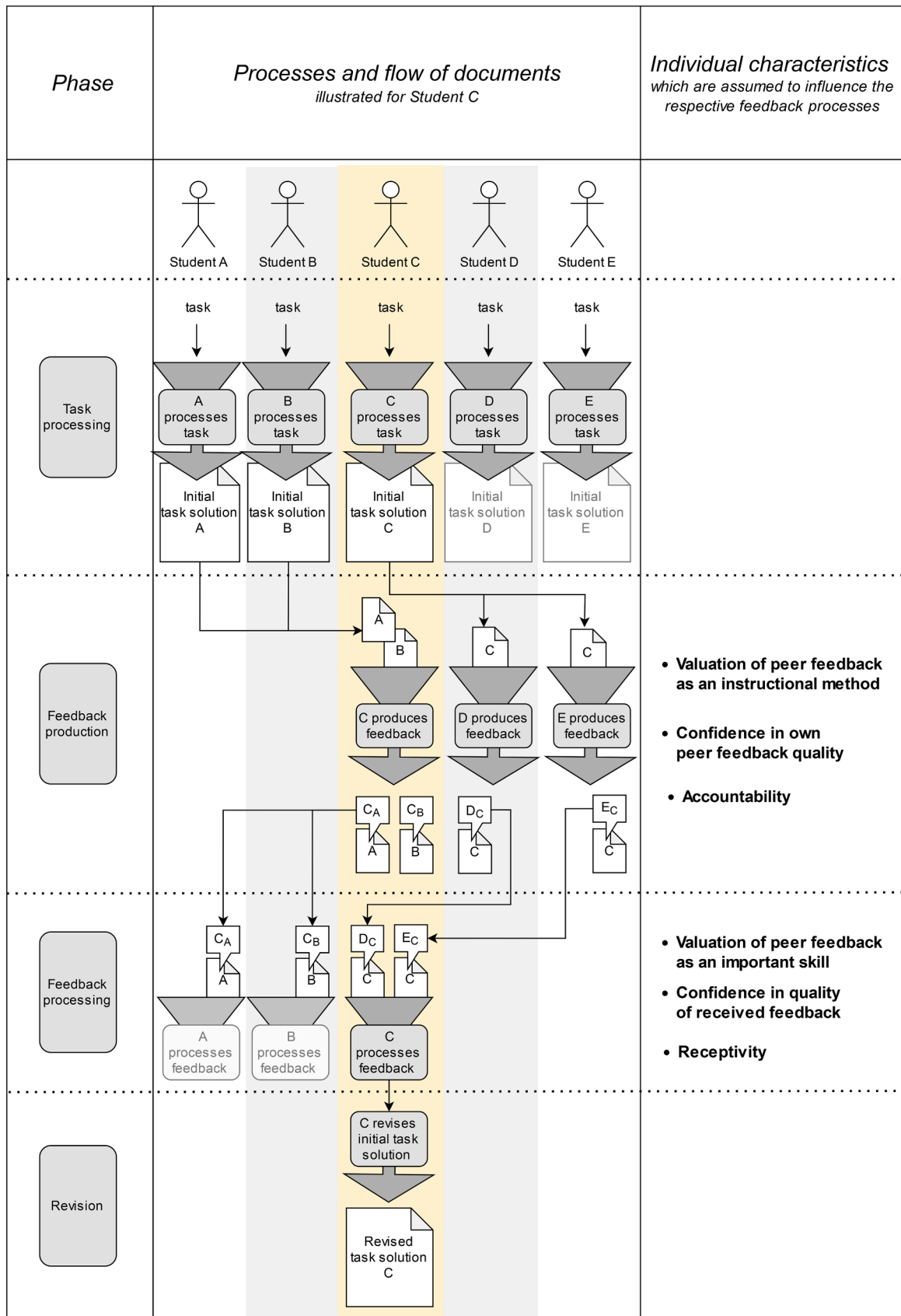
Fig. 1. The Steps of the Peer Feedback Process and corresponding Beliefs and Orientations.

However, these models focus on *receiving* feedback (Carless & Boud, 2018; Lui & Andrade, 2022b; Winstone, Nash, Parker, et al., 2017) and, therefore, are not specific to *peer* feedback. Surprisingly little research focuses on the individual motivational prerequisites involved in *providing* feedback though (van Popta et al., 2017). With regard to peer feedback specifically, it is not clear which mindsets, attitudes, and motivational variables uniquely contribute to promoting beneficial behavior in the peer feedback process. Therefore, the following sections elaborate on which (especially motivationally relevant) constructs may be important to consider for optimal functioning in both roles, as (a) feedback provider and as (b) feedback recipient (see Fig. 1).

4.1. Beliefs and orientations associated with feedback quality when providing peer feedback

Individual motivational prerequisites are likely to affect the quality of the feedback that individuals produce during peer feedback. To produce high-quality feedback, students' feedback literacy should be crucial (Carless & Boud, 2018). As part of feedback literacy, students need to be motivated to provide such high-quality feedback in the first place (Carless & Boud, 2018). Therefore, adequate beliefs and orientations toward peer feedback should determine motivation, for example according to the theory of planned behavior (Ajzen, 1991). Based on literature reviews and factor analytical approaches, two models have recently been published (Huisman et al., 2020; Kasch et al., 2022) that conceptualize these motivational components of peer feedback literacy. For providing high-quality feedback, valuation of peer feedback as an instructional method, confidence in own peer feedback quality, and accountability can be expected to be very relevant predictors of feedback quality (see Fig. 1). If they are combined, they describe complementary precursors of motivation to deliver feedback. From a classical motivational perspective (Ajzen, 1991; Eccles & Wigfield, 2002), valuation constitutes the value component of motivation, confidence the expectancy component, and accountability an intention. Therefore, these beliefs and orientations can be regarded as reflecting the motivational components of feedback literacy for the role as feedback provider.

We now discuss how these constructs should relate to feedback quality. Students who believe that engaging in peer feedback is meaningful and that implementing peer feedback in a given lecture is useful (Huisman et al., 2020), that is, students who *value peer feedback as instructional method*, should be well equipped to "appreciate the role of feedback in improving work and the active role in these processes (Carless & Boud, 2018, p. 1319)" and to recognize that feedback also comes from peers, not only teachers (both appreciating feedback). If students are *confident that the feedback they provide is of good quality* and will help their peers to improve their work (Huisman et al., 2020), they are likely able to "make sound academic judgements about […] the work of others" and to "participate productively in the peer feedback process" (making judgments; Carless & Boud, 2018, p. 1319). Students who feel responsible and committed to providing feedback that is helpful to the receiver (Kasch et al., 2022), that is, students who feel *accountable*, should "understand […] the active learner role in [feedback] processes" (appreciating feedback), likely "participate productively in peer feedback processes" (making judgements), and therefore be motivated to "develop capacities to make sound academic judgments about their own work and the work of others" (making judgements; Carless & Boud, 2018, p. 1319). In conclusion, valuation of peer feedback as instructional method, confidence in the quality of one's own peer feedback, and accountability should be motivational components of feedback literacy related to providing feedback, namely appreciating feedback and making judgements. We have dropped other constructs from Kasch et al. (2022) for the remainder of this article because they overlap to some extent with Huisman et al.'s concepts and also with perceived feedback adequacy (Strijbos et al., 2021). The overlap is likely due to the fact that general orientations do not clearly distinguish

between beliefs, attitudes, intentions, and behavior (Ajzen, 1991).

We assume that feedback literate students who are motivated to engage in peer feedback, that is, hold beliefs and an orientation as outlined above, produce feedback of higher quality than less favorably motivated students. The reason is that feedback literate students should be likely to engage in beneficial cognitive processes more intensely. Van Popta et al. (2017) reviewed literature focusing on the benefits of feedback production for the feedback provider. They summarized the cognitive processes involved in giving feedback as follows: Feedback providers compare their peers' solution against their own as a benchmark or compare it with other peer's solutions, question peers' ideas, evaluate their work and suggest modifications. Therefore, they need to reflect, plan, and regulate their own thinking, which leads them to think critically, make new knowledge connections, explain and take different perspectives. Even though these cognitive processes should be beneficial for their own learning, they are certainly cognitively demanding (Sweller, 2005). Therefore, students need to be properly motivated to engage in these processes. Feedback literate students who value the general activity, feel competent to engage in these processes, and feel responsible to execute these processes with sufficient quality, should be more motivated to engage in these cognitive processes than students without these beliefs and orientations. As a consequence of these high-quality cognitive processes, the resulting feedback should be of higher quality than the feedback of students with less beneficial beliefs and orientation. However, in one of the few studies that examined the effect of beliefs on the feedback provider, Alqassab et al. (2019) found no association with the learning outcomes for the feedback provider.

4.2. Beliefs and orientations associated with the perception of feedback when receiving peer feedback

Individual motivational prerequisites should not only have an impact on feedback provision, but also affect feedback processing (see Fig. 1). How a student processes a given feedback message should be determined at least by the properties of the message itself and the characteristics of the recipient (Lui & Andrade, 2022b). From the perspective of Lui and Andrade's (2022b) model about students' internal mechanisms of feedback processing, beliefs and orientations can be considered as initial states which provide a filter through which a received feedback message is processed. Then, emotions, interpretation of feedback, and decision-making should interplay when processing the feedback. These internal mechanisms decide if a feedback message is perceived as adequate (Strijbos et al., 2021), which, in turn, is likely to contribute to how students will act upon it (Lui & Andrade, 2022b).

Of the constructs that comprise relevant beliefs and orientations toward peer feedback (Huisman et al., 2020; Kasch et al., 2022), valuation of peer feedback as an important skill, confidence in the quality of received peer feedback, and receptivity can be assumed to influence feedback perception the most, as these constructs are conceptually linked to feedback processing. Again, they can be considered as determining motivation representing value, expectancy, and intention (Ajzen, 1991; Eccles & Wigfield, 2002).

Valuation of peer feedback as an important skill means that students find it important to be capable to "give constructive peer feedback", to "deal with critical feedback", and to "improve one's work based on received feedback" (Huisman et al., 2020, p. 332). Especially the latter two assertions indicate that this belief represents the motivational basis for processing feedback. In particular the capacities to "avoid defensiveness when receiving critical feedback" (managing affect), to "take action in response to feedback" and to "draw inferences from a range of feedback experiences for the purpose of continuous improvement" (taking action; Carless & Boud, 2018, p. 1319) may theoretically be affected by this valuation of peer feedback.

Confidence in quality of received peer feedback refers to students' assumptions on whether their peers will provide helpful and high-quality feedback (Huisman et al., 2020, p. 332). If this belief is high, students

can be assumed to be more likely to "appreciate the role of feedback in improving work" (appreciating feedback) as they believe in its high quality, "develop capacities to make sound academic judgments about their own work and the work of others" and "refine self-evaluative capacities over time in order to make more robust judgments" (both making judgements) because they feel that they can rely on the received feedback, "develop habits of striving for continuous improvement on the basis of internal and external feedback" (managing affect), and "draw inferences from a range of feedback experiences for the purpose of continuous improvement" (taking action; Carless & Boud, 2018, p. 1319), both because engaging with received feedback seems worthwhile as it is assumed to be of high-quality.

Finally, *receptivity* (Kasch et al., 2022) describes how much a peer feedback receiver values different perspectives regardless of sympathy for the feedback provider and of how positive or negative the feedback is. This openness to peer feedback is theoretically related to feedback literacy as it helps to appreciate feedback, to "refine self-evaluative capacities over time in order to make more robust judgments" (making judgments), to "maintain emotional equilibrium and avoid defensiveness when receiving critical feedback" (managing affect), and to "draw inferences from a range of feedback experiences for the purpose of continuous improvement" (taking action; Carless & Boud, 2018, p. 1319).

Overall, we argue that feedback literate students (i.e., students with high valuation of peer feedback, with high confidence in the quality of received peer feedback, and with high receptivity) are likely to interpret feedback as more adequate (at constant objective feedback quality) than less feedback literate students. Therefore, they probably experience fewer negative emotions, even when confronted with negative, unclear, or critical feedback (i.e., managing affect, Carless & Boud, 2018), and more positive emotions as especially critical feedback might provide valuable information to improve their own work. Consequently, it should be easier for them to experience peer feedback as just and fair because they should be able to evaluate the feedback less defensively and more objectively. For this reason, we expect them to also interpret the feedback as useful. Their interpretation of the received feedback might also be less dependent on the actual feedback quality because feedback literate students are likely able to take an active role and extract useful information even from low-quality feedback. As a result of this approach, we expect them to regard the feedback more acceptable than less feedback literate students.

These assumptions have not been tested empirically yet. However, there are a few studies that examined related constructs. Lui and Andrade (2022a) found only task value (as one of several variables representing learners' initial state) to be relevant for feedback processing variables. Aben et al. (2022) investigated the effect of (writing) self-efficacy on aspects of feedback processing and found no effect. Berndt et al. (2022) experimentally varied peer feedback senders' supposed competence and also found no effect on mindful processing of this feedback.

5. Research question and hypotheses

According to the theoretical models and reasoning outlined above, we assume that students' beliefs and orientations toward peer feedback will be associated with students' behavior in both roles during peer feedback: As feedback providers, the quality of the feedback they produce should be associated with their beliefs and orientations. As feedback receivers, we assume that beliefs and orientations will be associated with how adequate they perceive the peer feedback they receive. However, to our knowledge, these beliefs and orientations have hardly been examined together as a set of predictors of peer feedback behavior yet. Therefore, prior research has not considered possible unique contributions of these predictors on feedback provision on the one hand and feedback reception on the other. We therefore investigate whether and, if so, to what extent beliefs and orientations toward peer

feedback predict the quality of (a) provided peer feedback and (b) the perceived adequacy of received peer feedback. To this end, we set up the following preregistered hypotheses (https://osf.io/ndjxa):

As feedback providers:

1. The more students perceive peer feedback as a valuable instructional method, the higher is the quality of the feedback they provide.
2. The more confident students are to be able to provide high-quality peer feedback, the higher is the quality of the feedback they provide.
3. The more students feel accountable as a peer feedback provider, the higher is the quality of the feedback they provide.

As feedback receivers:

4. The more students value peer feedback as an important skill, the more students perceive the peer feedback they receive as adequate.
5. The more confident students are about receiving high-quality peer feedback, the more students perceive the peer feedback they receive as adequate.
6. The higher the receptivity as a peer feedback receiver is, the more students perceive the peer feedback they receive as adequate.

6. Method

6.1. Sample

From a total population of $N = 296$ pre-service teachers who participated in a lecture covering psychological topics relevant to teaching and learning, $N = 254$ consented to participate in our study and answered the pre-test questionnaire. Across four weeks, students were asked to use short educational theory texts to analyze problematic classroom situations that were part of a written case vignette about a lesson, give feedback to two peers, and use feedback from two (other) peers to revise their analysis. From the total sample, $N = 226$ students provided peer feedback messages, $N = 240$ received peer feedback, and $N = 189$ assessed the adequacy of the received feedback. Participation in the research study was voluntary, though providing an initial task solution, feedback to two peers, and a revision was obligatory to receive course credit. However, no specific grades were assigned to the students' products throughout this process. Nonetheless, students were engaged intensely during the whole peer feedback process: Their feedback messages were considerably long, that is, between 575 and 15.042 characters with an average of $M = 3.756$ ($SD = 2.115$). From initial solution to revision, students changed, on average, 23 % of the words (i.e., jaccard dissimilarity).

On average, students were 23 years old ($M = 22.56$, $SD = 4.30$) and in their fifth semester of studies ($M = 4.61$, $SD = 1.20$). Most students were female (77.95 %; 21.65 % male; 1 person did not indicate gender), which is typical for teacher education in Germany, where the study was conducted. Most students reported that they had engaged in peer feedback before, but not very often ($M = 2.62$, $SD = 1.04$, on a Likert scale from 1 = *do not agree at all* to 5 = *completely agree*, sample item, "I have often provided peer feedback"). Prior to the study, they most likely did not receive any training on how to provide and process peer feedback. Students in the course also should not have known each other due to different curricula for different majors and the size of the course. And even if they might have known some fellow students, as the peer feedback process was anonymous, students did not know who they provided feedback to and from whom they received feedback. However, they had already collaborated in (different) small groups for a previous task.

We report how we determined our sample size, all data exclusions, data from all experimental conditions, and all study measures relevant to the current research question (Simmons et al., 2012). Regarding sample size, we invited all students enrolled in the courses to participate without intermediate data inspection or a second wave of data collection. The final sample size was determined by the class size and students'

drop out from the class or study. The study complies with European rules regarding privacy protection and the ethical guidelines of the German Psychology Association.

6.2. Procedure

The study was embedded in the regular course as asynchronous, online work and lasted for three weeks (see Table 1). The goal of this course was that students develop skills to use educational theories to inform decisions about teaching (evidence-informed reasoning, Greisel, Wekerle, Wilkes, Stark, & Kollar, 2022). In the first week of the study (t1), participants answered an online questionnaire that included measures to assess their beliefs and orientations toward peer feedback, and analyzed a written case vignette. The case vignette (464 words) depicted one lesson in which a fictitious teacher made six pedagogical decisions which led to suboptimal learning outcomes. Students needed to identify those problems and analyze them one by one using evidence-informed reasoning (Greisel, Wekerle, Wilkes, Stark, & Kollar, 2022). That is, they should describe each problem they noticed in their own words, assign matching theoretical concepts, explain the causal relationship between these concepts, derive a goal, and develop alternative teacher actions. To equip the students for this reasoning, we provided them with two theory summaries (each about 800 words) about the ICAP model (Chi & Wylie, 2014) and cognitive load theory (Sweller, 2005). In addition, the students received a scheme that described each step of evidence-informed reasoning (Greisel, Wekerle, Wilkes, Stark, & Kollar, 2022). Furthermore, we added a worked example (Renkl, 2014) which demonstrated how the steps can be applied to a (different) case.

In the second week (t2), as feedback provider, each student anonymously reviewed the initial solutions of two randomly assigned peers, rated the quality of these solutions, and provided written feedback to both of their peers. In the third week (t3), as feedback receiver, each student received feedback messages from two peers, answered a questionnaire regarding the perceived adequacy of these feedback messages, and revised their initial solution based on the feedback.

This study is part of a larger study that aimed to investigate how to foster peer feedback quality and the quality of integration of multiple feedback messages (Hornstein, Greisel, & Kollar, 2024). The larger study comprised an experimental 2 × 2-design in which students received scaffolds on how to produce high-quality feedback (for the feedback provider role), on how to compare feedback messages to support their integration (for the feedback receiver role), both or none of these scaffolds. Regarding feedback providing, half of the sample received three prompts instructing the students to provide feed up, feed back, and feed forward (Hattie & Timperley, 2007) accompanied by a sample solution illustrating how such feedback might look like. The other half of the participants was only provided with a simple prompt "to provide feedback" without further guidance. Regarding feedback reception, half of the participants received step-by-step instructions about how to compare and integrate the two feedback messages each student received. The other half did not receive any guidance on how to handle the multiple feedback messages. The complete instructional material

Table 1
Study procedure.

Time	Students' Task	Measures
t1: Week 1	Initial task solution: Analyzing problems in case vignette	• Beliefs and orientations towards peer feedback (questionnaire)
t2: Week 2	Providing feedback: Reading the problem analyses of peers and writing feedback messages	• Quality of initial task solution (questionnaire) • Quality of peer feedback (coded)
t3: Week 3	Receiving feedback: Read received feedback messages and revise problem analyses accordingly	• Perceived feedback adequacy (questionnaire)

can be found at OSF (https://osf.io/whgde/). The effects of these experimental manipulations are reported elsewhere (Hornstein, Greisel, & Kollar, 2024). For the purpose of the current article, however, we included the experimental conditions as covariates to control for potential effects on the associations of beliefs and orientations with feedback quality and perceived adequacy. Therefore, as the experimental conditions did not concern our research questions, we will present the analyses of the entire sample without differentiating between the four conditions.

6.3. Instruments

Students' *beliefs* were measured with the Beliefs about Peer-Feedback Questionnaire (Huisman et al., 2020) on a Likert-scale from 1 = *completely disagree* to 5 = *completely agree.* The questionnaire consists of four dimensions. The dimension confidence in own peer-feedback quality comprised two items with a correlation of r (Spearman-Brown) = .78 (sample item: "In general, I am confident that the peer-feedback I provide to other students is of good quality"), and the dimension valuation of peer-feedback as instructional method included three items, yielding a Cronbach's α = .80 (sample item: "Involving students in feedback through the use of peer-feedback is meaningful"). The dimension confidence in quality of received peer-feedback was measured with two items that correlated with r (Spearman-Brown) = .87 (sample item: "In general, I am confident that the peer-feedback I receive from other students is of good quality") and the dimension valuation of peer-feedback as an important skill with three items and α = .87 (sample item: "Being capable of improving one's work based on received peer-feedback is an important skill").

Orientations toward peer feedback were measured with the Peer Feedback Orientation Scale (Kasch et al., 2022) on a Likert-scale from 1 = *completely disagree* to 5 = *completely agree.* From the whole questionnaire, we used only the dimension accountability (five items with McDonalds $\omega_{hierarchical}$ = .70; sample item: "As a peer-feedback provider, I feel responsible to give feedback that helps the other person"), and the dimension receptivity (four items with McDonalds $\omega_{hierarchical}$ = .83; sample item: "As a peer-feedback receiver, I think that even if someone else has a different point of view, there may still be something valuable in it").

To examine factorial validity of the predictors, we performed a confirmatory factor analysis. The analysis was estimated using maximum likelihood with the lavaan package [0.6–14] (Rosseel, 2012) and R [4.2.2] (R Core Team., 2022). All items from the scales measuring beliefs and orientations were modelled as loading only on the one theoretically intended latent variable described above. The resulting model fit, $X^2(137) = 340.236$, $p < .001$, CFI = .92, TLI = .90, RMSEA = .076, SRMR = .066, can be considered acceptable given the small item number for some of the scales and the theoretical similarity or overlap between some of the scales.

Feedback quality, as outcome variable in the feedback provider role, was determined by objectively coding the written feedback messages. Two trained raters who were blind to condition independently coded 10 % of the feedback messages and achieved satisfying interrater agreement (Gwet's AC1 = .65–1.00). The categories (see Table 2) were derived from the literature on effective feedback ingredients. They are intended to capture the formal features of peer feedback—not content-related aspects such as the accuracy of feedback comments. Formal feedback features should be independent of the domain-specific content of a feedback message. In contrast, content-related features of peer feedback address how accurate the feedback is and how relevant its praise and criticism are with respect to some task-specific standard. We chose this narrow focus on formal features to better address our research questions: Beliefs and orientations toward peer feedback relate to peer feedback as a method, not to any specific task content. The accuracy of feedback comments is logically determined by prior knowledge and skills related to the task, not to the learning method. Therefore, beliefs

Table 2
Category system to code the formal feedback quality.

Category	Definition	Example[1]	Codes
Feed Up Aims	*Feed Up Aims* is used to code whether the feedback message describes what students had to do. The following aspects comprised the task: 1. Problems in the case vignette should be analyzed. 2. This analysis should follow the five steps of evidence-informed reasoning (problem identification, problem description, problem explanation, goal setting, and selecting actions). 3. The ICAP model (Chi & Wylie, 2014) and the cognitive load theory (Sweller, 2005) should be used as a theoretical basis. 4. Each of the six problems from the case should be analyzed separately. Additionally, a high-quality feed up also explains why students should use the five steps.	"Unfortunately, you forgot to consider the structure first: 1. Problem description 2. Problem explanation 3. Goal setting 4. Deciding for action"	0 = *no task criteria present* to 3 = *all five aspects are present*
Feed Up Copy[2]	Only applies if *Feed Up Aims* is present: *Feed Up Copy* is used to code whether students wrote the Feed Up in their own words or copied from the template.	"Our task was to identify problems from the case related to the ICAP model and cognitive load theory and to analyze them using the theory. Ideally, we would have followed the five steps of "problem identification, problem description, problem explanation, goal setting, and deciding for action". Together, these form a scheme that should encourage us to use scientific knowledge in our analysis and thus arrive at more professional solutions. This scheme should then be applied in such a way that each problem is subjected to a separate analysis. So, for each problem, the steps are worked through in full."	0 = *copied*, 1 = *not copied*
Feed Back Concordance	*Feed Back Concordance* is used to code whether the reviewer comment points out that an aspect of the initial task solution fulfills the task criteria. Technically, this means that the actual value matches the setpoint defined by the task. It does not matter how detailed the match between the actual and the setpoint is described; only the reference to an achieved congruency is necessary. That is, expressions like "good" or "nice" are enough.	"Here, the intrinsic load will certainly be very high as Ms. Bender does not activate the prior knowledge of the students, and, as you have already mentioned correctly, she also sets a very unclear task. That is why the extraneous load is also high."	0 = *not present* to 2 = *present in all problem analyses*
Feed Back Discrepancy	*Feed Back Discrepancy* is used to code whether a reviewer comment names a discrepancy between how the initial task solution was written and how it should look like. Technically, this means that the written actual deviates from the setpoint defined by the task. It does not matter how detailed the actual-setpoint-deviation is described; only a reference to a discrepancy is necessary. Expressions like "incorrect" or "wrong" are enough.	"This aspect does not contribute to accomplish the task."	0 = *not present* to 2 = *present in all problem analyses*
Feed Forward	The code *Feed Forward* covers statements with suggestions for how to improve the initial solution.	"However, the problem could be described in more detail (refer to the ICAP model, briefly describe it, then explain why this passive learning activity does not lead to much knowledge acquisition)."	0 = *not present* to 2 = *present in all problem analyses*
Task[2]	*Task* is used to code whether the feedback message contains information about the correctness of the problem analysis, that is, what was done correctly or incorrectly, or whether an aspect is missing with which the task could be considered correct.	"You have identified and described the problem well."	0 = *fulfillment of task criteria is not addressed*, 1 = *fulfillment of task criteria is addressed*
Process	*Process* is used to code whether feedback messages do not only contain a description of what was done correctly or incorrectly but also include suggestions for how the problem analysis can be improved and for how the mentioned mistakes can be corrected or avoided (see Hattie and Timperley, 2007, for an in-depth description of the difference between task and process level).	"Why is it problematic that students only passively engage with the text instead of interactively as Ms Bender had intended?"	0 = *feedback comment does not refer to the learning process*, 1 = *feedback comment refers to the learning process*
Additional Stimulation	*Additional Stimulation* is used to code whether the reviewer illustrated theoretical statements and abstract explanations with examples or quotations from the initial task solution to facilitate understanding. Quotations can be direct or indirect. Examples are stimulating if they can be inserted in the revision as is, that is, without alteration.	"In your revision, you could write: 'Ms Bender should hand out the texts one at a time.'"	0 = *not present*, 2 = *present in all problem analyses*
Reference to Theory	*Reference to Theory* is used to code whether the ICAP model or the cognitive load theory or related technical terms such as extraneous cognitive load or active/passive/interactive learning activities are mentioned. Simply mentioning the term is sufficient. However, mentioning it in the *Feed Up* does not count.	"Also, the ICAP model does not say (as your version does) that you have to start with passive learning activities, but of course you can."	0 = *not present* to 2 = *present in all problem analyses*
Elaboration	*Elaboration* represents the length of the feedback message measured by the number of characters.		

Note. [1]Examples are from different participants. [2]Due to a lack of variance, the task variable was not considered in the final factor score. Furthermore, Feed Up Copy could not be integrated, too, as it logically only applies to a subset of the data.

and orientations should be associated with features of peer feedback that are agnostic to the domain-specific content of feedback. To reflect the Hattie and Timperley model (2007), we coded (1) how complete the criteria from the task were described (feed up), (2) if students wrote where the solution was as expected (concordant feed back) and (3) where it did not satisfy the set goal (discrepant feed back), and (4) if it contained suggestions for improvement (feed forward). In addition, we coded (5) if the feedback message contained information regarding the process of the case analysis (process level). To reflect the general finding from the literature that elaborated feedback is superior to simple verification, we also coded if the feedback message contained (6) additional explanations or examples and (7) concepts from the accompanying theory texts. We also wanted to code the specificity or localization (Patchan et al., 2016) of the feedback message, but this concurred strongly with the mere length of the feedback message. Therefore, we used (8) the character length of the feedback message as indicator for specificity.

To judge the content validity of our coding scheme, we collected expert opinions following the recommendations for expert validity studies from Beck (2020), who argues that it is not the number of experts, but rather their eminent expertise that counts when conducting such studies. Based on a systematic search via Web of Science, we identified the five researchers with the highest number of publications on peer feedback and asked them to answer a short questionnaire. Three of them responded (Christian Schunn, Omid Noroozi, Ernesto Panadero). The questionnaire contained a description of the background, a definition of the variable we wanted to measure with the coding scheme, a description of the study background, an explanation of the codes, and the coding scheme itself. The experts were asked to rate the item "The coding scheme as a whole represents the construct 'formal peer feedback quality' well" on a Likert scale from 1 = *strongly disagree* to 6 = *strongly agree*. The experts' mean average rating was 4. In addition, we asked them to explain their rating to understand potential criticism better. Given that a large proportion of their criticism does not affect the research question in the present paper, we consider a value of 4 as evidence of a satisfactory content validity for this research question.

Finally, as an exploratory factor analysis did not suggest (based on Kaiser-Guttman-Criterion, Scree Plot, and Map-Test) more than a single main component, we combined all dimensions into a single score. To do this, we first normalized the "elaboration" category (number of characters), then calculated the factor scores using the regression/Thurstone method in the context of a one-factor confirmatory factor analysis using the WLSMV estimator due to the ordinal measurement level of some of the variables, and saved them as a variable. These factor scores are standardized and independent of the originally different scaling of the coding categories (DiStefano et al., 2009) and are used twice in our analyses: On the one hand, we calculated the mean of the two scores (as each person produced two feedback messages) representing the feedback quality that students provided. We used this quality of provided feedback as the dependent variable in the first regression analysis. On the other hand, we also calculated the mean of the two feedback messages that one student received from their peers and used this quality of received feedback as control variable in the second regression analysis.

Perceived adequacy of peer feedback, as the outcome variable in the feedback receiver role, was measured with the Feedback Perceptions Questionnaire (Strijbos et al., 2021) on a Likert-scale from 1 = *completely disagree* to 9 = *completely agree*. To determine adequacy, we calculated the average, as suggested by Strijbos et al. (2021), across the three dimensions fairness (sample item: "I would consider this feedback justified"), usefulness (sample item: "I would consider this feedback useful"), and acceptance (sample item: "I would accept this feedback") with three items each. McDonalds $\omega_{hierarchical}$ for this aggregated scale was .80.

Initial solution quality measured how well a student—from the perspective of their peer who reviewed the respective initial task solution —executed the steps of evidence-informed reasoning in their case analysis. To this end, the reviewing peers answered five items with the sentence starter "Overall, my fellow student succeeded, using the ICAP model and cognitive load theory, in …" followed by items (sample item: "…correctly explaining teaching problems") concerning identifying teaching problems, explaining them, predicting their development, justifying a goal, and deriving options for action. All items were answered on a Likert-scale from 1 = *completely disagree* to 5 = *completely agree* with McDonalds $\omega_{hierarchical}$ = .82. The initial solution quality was included as a covariate, allowing us to control for differences in the quality of the task solutions students got to review because the quality of these solutions might influence the way reviewers write their feedback message.

7. Results

As preliminary analysis, we checked for gender differences because Noroozi et al. (2020) found that feedback quality differed by dependent on gender. However, female students did not differ from male students in regard to single indicators of feedback quality or the overall feedback quality score. In addition, the regression results reported in the following did not change when gender was included as a control variable (see supplemental material). Therefore, we dropped gender from further consideration.

Descriptive statistics and bivariate correlations are presented in Table 3. Both orientations toward peer feedback, that is accountability and receptivity, valuation of peer feedback as an important skill, and perceived feedback adequacy showed means close to the upper end of their scale, whereas the other measures were answered more in the middle of the scale on average. Beliefs and orientations showed low to moderate associations with each other. Objectively coded feedback quality and initial solution quality were not related to any of the other variables. Perceived feedback adequacy was hardly associated with all beliefs and orientations.

To determine the unique contributions of each predictor, we

Table 3
Means, standard deviations, and bivariate correlations.

Variable	M	SD	1	2	3	4	5	6	7	8	9
1. Valuation of peer feedback as instructional method	3.73	0.86									
2. Confidence in own peer feedback quality	3.56	0.69	.44**								
3. Accountability	4.53	0.56	.23**	.44**							
4. Valuation of peer feedback as an important skill	4.54	0.63	.48**	.47**	.57**						
5. Confidence in quality of received peer feedback	3.46	0.81	.56**	.53**	.29**	.45**					
6. Receptivity	4.44	0.61	.33**	.46**	.66**	.56**	.38**				
7. Quality of provided peer feedback	0.00	0.70	−.06	−.01	.01	.01	−.06	−.05			
8. Quality of received peer feedback	0.04	0.78	.10	.01	.05	.06	.06	−.03	.24**		
9. Perceived feedback adequacy of received peer feedback	7.29	1.25	.19*	.16*	.19*	.26**	.25**	.29**	.09	.10	
10. Initial solution quality	3.97	0.75	−.02	−.02	−.01	.00	−.08	−.08	.08	−.09	−.08

Note. M and *SD* are used to represent mean and standard deviation, respectively.
* $p < .05$. ** $p < .01$.

Table 4
Feedback provider role: regression of quality of provided peer feedback on beliefs and orientation.

Predictors	B	SE	β	Standardized SE	p
(Intercept)	−0.94	0.54	−0.00	0.07	0.085
Valuation of peer feedback as instructional method	−0.06	0.06	−0.07	0.07	0.374
Confidence in own peer feedback quality	0.03	0.08	0.02	0.08	0.746
Accountability	0.00	0.10	0.00	0.07	0.979
Control: Initial solution quality	0.18	0.07	0.18	0.07	**0.008**
Control: Feedback scaffold	0.63	0.09	0.46	0.07	**< 0.001**
Observations	178				
R^2 / R^2 adjusted	0.225 / 0.202				

Table 5
Feedback receiver role: regression of perceived feedback adequacy of received peer feedback on beliefs and orientation.

Predictors	B	SE	β	Standardized SE	p
(Intercept)	3.23	0.90	0.00	0.07	**< 0.001**
Valuation of peer feedback as an important skill	0.43	0.20	0.17	0.08	**0.033**
Confidence in quality of received peer feedback	0.04	0.14	0.02	0.08	0.769
Receptivity	0.50	0.19	0.20	0.08	**0.011**
Control: Quality of received feedback	0.30	0.14	0.19	0.09	**0.032**
Control: Feedback scaffold	0.09	0.25	−0.08	0.08	0.709
Control: Integration scaffold	−0.39	0.24	−0.28	0.07	0.104
Control: Feedback scaffold * Integration scaffold	−0.63	0.34	−0.13	0.07	0.069
Observations	177				
R^2 / R^2 adjusted	0.225 / 0.193				

calculated linear multiple regressions. In preliminary scatter plots, all relations appeared to be linear. Residuals showed homoscedasticity and were normally distributed. A sample of Durbin Watson tests indicated no autocorrelation of residuals (independent errors). All predictors had a variance inflation factor close to one, which is the lowest value possible, and far from larger than 5, which would indicate multicollinearity. To identify outliers, we used a combination of studentized residuals, hat values, and Cook's distance. Seven participants with extreme values on one or multiple variables were excluded because they exhibited an influence on the regression model above traditional cut-offs (Hardin & Hilbe, 2007; Stevens, 2002).

For the feedback provider role, the quality of provided peer feedback was not significantly predicted by any of the three beliefs and orientation (Table 4). For the feedback receiver role, the perceived adequacy of the received feedback was significantly predicted by valuation of peer feedback as an important skill, β = 0.17, p = .033, and receptivity, β = 0.20, p = .011, each with a small standardized effect (Table 5).

To complement these analyses, we also present partial correlations between each set of predictors and the outcomes for providing and receiving feedback phases (Tables 6 and 7).

To exploratorily check for alternative explanations, we repeated the regression analyses with additional covariates to control for prior content knowledge, seriousness of study participation, prior experience with peer feedback, and the quality of the feedback students provided themselves. None of these additional analyses altered the results

regarding the effects of beliefs and orientations significantly.

8. Discussion

Our research question was to what extent beliefs and orientations toward peer feedback predict students' behavior in both roles, as feedback providers and feedback receivers. Therefore, we measured the quality of provided peer feedback on the one hand and the perceived adequacy of received peer feedback on the other. We conceptualized beliefs and orientations toward peer feedback as the motivational component of feedback literacy (Carless & Boud, 2018), which, in turn, is assumed to be a necessary prerequisite for students' successful participation in peer feedback.

Regarding providing peer feedback, we found that the beliefs "valuation of peer feedback as an instructional method", "confidence in own peer feedback quality", and "accountability for helpful feedback" were not associated with the quality of the provided peer feedback. Thus, our hypotheses regarding feedback quality were not supported by our data. Nevertheless, these findings are in line with empirical research with similar constructs, which also reported unexpected null-effects in this regard (Aben et al., 2022; Alqassab et al., 2019; Berndt et al., 2022; Lui & Andrade, 2022a), though there are theoretical strong reasons to assume such relations as elaborated in the theoretical part above.

These null-effect findings could be interpreted in at least two ways. First, individual motivation may be less relevant to providing peer feedback than assumed. A peer feedback setting constitutes an instructional context that is different from a typical teacher-based feedback setting. Carless and Boud (2018) already elaborated on how peer feedback might constitute a context that is ideal for developing feedback literacy. This context supports that students engage intensively in certain activities, such as making judgements, which is inevitable when providing peer feedback, or taking action on feedback, which is at least very likely when students are prompted to revise their initial solutions. Exactly these features of a peer feedback context might have been the reason why most of the beliefs and orientations investigated here were not associated with the feedback quality: The instructional context might have been so supportive of the processes necessary to produce feedback that it rendered individual differences regarding motivation to engage in peer feedback irrelevant. That is, our peer feedback setting may have functioned as an external scaffold that allowed also students with less favorable beliefs and orientations to effectively engage in peer feedback production so that there might have been no need for students to motivate themselves to engage in feedback-related activities.

Second, theoretically, other motivations which are not specific to peer feedback as instructional method, such as general achievement goals or task specific goals (Hulleman et al., 2010), might have been so prominent that they obscured the effect of beliefs and orientations specific to peer feedback. For example, students may have considered it important to perform well in a scenario relevant to their future teaching practice and necessary to gain credit points, regardless of their beliefs about peer feedback in particular. Therefore, they may have been motivated to provide high-quality feedback, even if they did not believe peer feedback as a method to be effective or valuable. This interpretation corresponds with the finding from a study of Lui and Andrade (2022a): There, only the value students attributed to the task affected their feedback processing, but not other variables that make up students' initial state. Unfortunately, we could not test this interpretation, as we did not measure other motivational constructs in our study. However, future research might compare the influence of different aspects of motivation within instructional contexts moderated by different levels of external scaffolding.

Regarding the perception of peer feedback, we found significant bivariate correlations of beliefs and orientation with feedback adequacy, which were mostly confirmed by the regression analysis. Valuation of peer feedback as important skill and receptivity were significantly associated with the perceived feedback adequacy. This finding may

Table 6
Feedback provider role: partial correlations for quality of provided peer feedback and beliefs and orientation.

	1	2	3	4
1. Valuation of peer feedback as an important skill	-			
2. Confidence in quality of received peer feedback	0.32***	-		
3. Receptivity	0.13	0.36***	-	
4. Covariate: quality of received feedback	0.02	−0.05	<0.01	-
5. Feedback quality	−0.07	0.03	0.01	0.08

* $p < .05$. ** $p < .01$. *** $p < .001$.

Table 7
Feedback receiver role: partial correlations for perceived feedback adequacy of received peer feedback and beliefs and orientation.

	1	2	3	4
1. Valuation of peer feedback as an important skill	-			
2. Confidence in quality of received peer feedback	0.28***	-		
3. Receptivity	0.54***	0.17*	-	
4. Covariate: quality of received feedback	0.06	0.08	−0.08	-
5. Perceived feedback adequacy	0.05	0.10	0.16*	0.08

* $p < .05$. ** $p < .01$. *** $p < .001$.

indicate that the capacities to "avoid defensiveness when receiving critical feedback" (managing affect), to "take action in response to feedback" and to "draw inferences from a range of feedback experiences for the purpose of continuous improvement" (Carless & Boud, 2018) was indeed fostering a perception of feedback as fair, useful, and acceptable. Moreover, the more students perceive themselves as open to perspectives and opinions that differ from their own, whether positive or negative, the more they seem to perceive the feedback they received as fair, useful, and acceptable. From the perspective of Lui and Andrade's model (2022b), the openness to different perspectives may help to avoid a defensive stance when facing criticism (Carless & Boud, 2018) and foster a positive emotional response to feedback, which, in turn, would help to perceive it as adequate (and act upon it).

Confidence in the quality of received peer feedback was not associated with perceived feedback adequacy in the regression analysis. This may indicate that two effects canceled each other out: On the one hand, students with high confidence in the quality of received feedback should have appreciated the feedback more and therefore rated it as more adequate generally. On the other hand, students with low confidence in the quality might have been investigating the quality of the feedback they received more thoroughly, rather than relying on their peers' ability to provide quality feedback. Since they may have invested more effort in making judgements, they might have been able to see value in less than optimal feedback messages as well, resulting in better ratings for these messages.

Furthermore, it may be that students' confidence in the quality of received peer feedback does indeed matter for processing peer feedback in the feedback receiver role. Though, it may affect behavior in different ways than we argued. Rather than influencing the perceived adequacy of feedback, which in turn should steer implementation of feedback comments, these beliefs may encourage implementations of feedback comments regardless of their perceived adequacy. This could be the case if the beliefs regarding peer feedback (erroneously) prioritized taking action over making judgements. For example, students might skip assessing the feedback adequacy. Instead, they might focus entirely on interpreting the feedback in terms of how to implement each comment. However, this behavior would not be considered as feedback literate as it ignores making judgements and developing own evaluation competencies. Since we did not investigate implementation here, we could not

test this interpretation. Future research should investigate whether making judgements as part of feedback literacy moderates the role of perceived feedback adequacy in determining feedback implementation.

9. Limitations

This study is not without limitations, of course. First, we did not analyze learning outcome variables as we were interested in feedback provision and perception. Therefore, the possible interpretation regarding alternative routes of feedback processing outlined above could not be ruled out.

Second, it might be that students may have had too little prior experience with peer feedback, despite having studied in higher semesters and reporting at least some experience. This may have rendered their initial self-reports at the beginning of the study questionable for predicting actual behavior during the peer feedback process.

Third, there may have been ceiling effects in our outcome variables that reduced the potential to find associations. For the objectively coded feedback quality, this is difficult to determine as there is no finite scale. Regarding perceived feedback adequacy, there surely is no extreme ceiling effect. Though, the distribution seems to be cut off a bit on the right side, indicating a possible slight ceiling effect. If there were ceiling effects, this would explain the lack of assumed associations between beliefs and orientations and feedback quality and perceived adequacy, but it would also support our interpretation that peer feedback as instructional context supported the feedback giving and processing to a great extent.

Fourth, the coding of peer feedback quality could be called into question, that is, it may have failed to represent relevant aspects of quality. The results of the expert validation, however, seem to imply that our coding scheme reflected feedback quality to a sufficient extent. Nevertheless, the experts also saw room for improvement. Therefore, future research should develop alternative coding schemes to assess feedback quality.

Fifth, the sample comprised pre-service teachers from a single university who were predominantly female. Although students from various majors were included, effects may be different in other samples. Thus, more studies are needed to judge the generalizability of our findings.

Sixth, we used an instructional setting that, for example, employed a specific task (analyzing problematic classroom situations using evidence-informed reasoning). Therefore, we do not know how our findings generalize to other tasks, which are likely to involve different text genres. The same is true for topic familiarity. Pre-service teachers should be familiar with lesson planning and pedagogical problem solving. Thus, it is unclear how they would perform on a less familiar topic. In addition, the teacher was not present during the entire peer feedback process, which was online and asynchronous. Hence, additional teacher support or feedback could also make a difference.

10. Implications and conclusions

On the one hand, our findings suggest that the *perception* of peer feedback is affected by individual motivational prerequisites in a similar way to what is known about the reception of teacher feedback. On the other hand, feedback *providing* seems not to be associated with individual motivational prerequisites. Bearing the aforementioned limitations in mind, these findings have the following implications. Regarding theory, this adds to the literature, which is predominantly reflecting cognitive mechanisms that explain why peer feedback can be effective even beyond teacher feedback, a possible motivational mechanism: Providing peer feedback may comprise an instructional context that renders individual differences in motivation toward feedback less relevant than they are when students process feedback. If this interpretation was confirmed by future studies, it would mean that research needs to distinguish sharply between feedback providing and receiving when

considering interindividual motivational prerequisites. Especially the concept of feedback literacy (Carless & Boud, 2018) would need to incorporate this differentiation.

Regarding practice, hence, our findings are, in part, good news for instructors: A well-designed peer feedback setting seems to scaffold students' engagement in a way that allows students with lower feedback literacy to successfully provide high-quality feedback. However, students' difficulties when it comes to interpreting teacher feedback that were documented in the literature (Gravett & Winstone, 2019; Winstone, Nash, Rowntree, et al., 2017) seem to be present in the peer feedback setting as well.

As receptivity seemed to influence the perception of received feedback, appreciating different perspectives and taking a constructive stance toward criticism should be promoted through appropriate training or other support measures. Fulham et al. (2022) reviewed specific barriers to receptivity. For example, students might need to protect their sense of self or their self-esteem. In addition, feedback might be written in a way that attacks the receiving person. Furthermore, feedback receivers might perceive feedback providers as lacking credibility. These barriers could be addressed by instructors in order to raise receptivity for feedback. Instructors could take over responsibility to establish an error-friendly environment in their classrooms, and to train their students to formulate feedback that addresses the task, process, and self-regulation level instead of the self-level (Hattie & Timperley, 2007). To address the credibility, technical solutions may be implemented that allow feedback providers to indicate how sure they are about their recommendations. This would help receivers to assess the credibility of the feedback comments and avoid over-generalization of weakly supported feedback comments to peer feedback in general.

Moreover, students' valuation of peer feedback as an important skill appeared to be associated with how adequate students perceived the feedback they received. Teachers might try to promote this belief with interventions such as having students write reflections about potential benefits of peer feedback skills for their personal future or measures to increase the intrinsic value of peer feedback (Rosenzweig et al., 2022). In general, our study helps to identify which motivational aspects regarding peer feedback instructors should directed their attention to.

In conclusion, we investigated to which extent higher education students' beliefs and orientations toward peer feedback predicted the quality of the feedback they provided and how adequate they perceived the feedback they received. We found no associations for peer feedback quality; yet, valuation of peer feedback as an important skill and receptivity were associated with feedback perception. We conclude that the instructional context in a peer feedback setting may be powerful to compensate for a priori differences in students' motivationally relevant beliefs and orientations especially when providing feedback, but beliefs and orientations seem to matter for processing feedback.

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CRediT authorship contribution statement

Martin Greisel: Writing – original draft, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Julia Hornstein:** Writing – review & editing, Methodology, Investigation, Data curation, Conceptualization. **Ingo Kollar:** Writing – review & editing, Supervision, Methodology, Investigation, Funding acquisition, Conceptualization.

Conflict of Interest

We have no known conflict of interest to declare.

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.stueduc.2024.101438.

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