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Validating the concept of immediacy of strategy use for the regulation of collaborative learning: Results from an expert study

Laura Spang *, Martin Greisel, Ingo Kollar

Department of Educational Psychology, University of Augsburg, Universitätsstr. 10, 86135, Augsburg, Germany

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ABSTRACT

During collaborative learning, different types of regulation problems such as cognitive, metacognitive, motivational, and emotional problems between group members may hinder the learning process. Once groups have noticed a problem, they need to apply a regulation strategy for the problem to alleviate it. Yet, so far, it is unclear which regulation strategies to use in the light of what problem. Therefore, we propose the concept of *immediacy of strategy use*: A regulation strategy is considered immediate for a problem if it can solve this problem without further strategies necessary. In this study, we tested the content validity of this immediacy concept by using an expert study methodology. We explored (a) which regulation strategies experts regard as immediate for which problems, (b) to what extent they agree in their immediacy ratings, and (c) whether they distinctly categorize regulation strategies into immediate and non-immediate strategies for specific problems. $N = 59$ experts rated the immediacy of 27 regulation strategies for eight social regulation problems. Our results indicate that experts can concordantly identify an immediate regulation strategy for regulation problems. The only exceptions were the regulation problems "Incompatible Working Methods" and "Unfair Distribution of Work Load". Additionally, for each problem, we could clearly differentiate between various immediate and non-immediate regulation strategies. In summary, our findings strongly support the content validity of the immediacy concept. Future research could implement and investigate the immediacy concept in educational practice to support immediate strategy use for problem regulation during collaborative learning.

1. Introduction

Collaborative learning can be defined as activities in which multiple learners work together to learn something (Dillenbourg, 1999). Even though collaborating with others can lead to beneficial and substantial effects on cognitive and motivational learning processes and outcomes (e.g., Kyndt et al., 2013), groups often face a broad range of problems during collaboration, such as an unfair distribution of work load, a low quality of discussions, or single group members being not interested in and therefore not contributing to the group work. If groups do not manage to regulate such problems effectively, this may drastically impede their learning process (e.g., Järvenoja et al., 2013; Järvenoja & Järvelä, 2009; Koivuniemi et al., 2017).

Once groups have noticed a problem (Järvenoja & Järvelä, 2009), they need to select and apply a regulation strategy, out of the pool of cognitive, metacognitive, motivational and resource-oriented regulation strategies, that "fits" the problem (Hadwin et al., 2018; Steuer et al., 2019). Yet even though the idea of "problem-strategy-fit" has been used in prior research to judge groups' regulation efforts and success (Bakhtiar & Hadwin, 2020; Steuer et al., 2019), it has hardly been clearly defined so far. For the most part, the dominating view seems to be that "problem-strategy-fit" is present when groups use a regulation strategy that somehow helps alleviate the problem at hand (Engelschalk et al., 2016).

In this article, however, we argue that the explanatory value of such a broad understanding of "fit" is rather limited, as in principle, many problems can be alleviated by a broad range of regulation strategies. Yet, for any specific problem, it is likely that only a very limited number of strategies are suited to *address the core of the problem and can solve it*, at least if that strategy is applied with high quality. For such situations, we suggest that said strategy is "immediate" for the solution of the particular regulation problem at hand. We argue that the idea of "immediacy of strategy use" has at least three advantages when compared to the rather broad notion of "problem-strategy-fit": First, knowing which regulation strategy is immediate for which problem will help educators provide more targeted scaffolding for groups. Second, the immediacy

* Corresponding author. Universitätsstr. 10, 86135, Augsburg, Germany.
E-mail addresses: laura.spang@phil.uni-augsburg.de (L. Spang), martin.greisel@uni-a.de (M. Greisel), ingo.kollar@uni-a.de (I. Kollar).

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concept includes the description of a clear mechanism that determines the suitability of a regulation strategy for a problem situation a priori, that is, before its effects are known. And third, this mechanism allows to derive a list of immediate problem-strategy combinations, which may inform the systematic design of empirical studies to determine what regulation strategies are "immediate" in solving specific regulation problems.

So far, we have gathered first evidence that supports the criterion validity of the immediacy concept by observing that the use of immediate regulation strategies in a real-life collaborative setting is associated with group members' satisfaction with their collaboration (Melzner et al., 2020). What is lacking though is a determination of the *content validity* of the immediacy concept. In this article, we approach this via an *expert validation* approach: More specifically, we asked experts from research on regulated and collaborative learning to judge the immediacy of a broad range of regulation strategies for a set of social problems that may emerge during small-group collaboration. That way, we aimed to probe the usefulness and applicability of the immediacy concept to better understand the relation between different regulation strategies and regulation problems, in order to inform both educational research and educational practice on this matter.

2. Theory

2.1. Regulation problems during collaborative learning

Groups may face a range of regulation problems during collaborative learning, which are often caused by differences between group members. These differences can refer to the cognitive, the metacognitive, the motivational, and the emotional level (e.g., Järvenoja et al., 2013; Koivuniemi et al., 2017).

Cognitive regulation problems refer to challenges that are caused by differences in the group members' knowledge and thinking about or understanding of subject matter information. For example, they may emerge when group members have a *different understanding of technical terms regarding the learning content* (e.g., Järvenoja et al., 2013). Such a situation may occur when group members interpret technical terms differently, or when the group holds an overall misunderstanding of important concepts. Furthermore, cognitive regulation problems may arise from a *lack of information exchange,* for example, when a learner does not share topic-related information with their peers (Strauß & Rummel, 2018).

At the *metacognitive* level, groups may experience regulation problems regarding planning, monitoring, and reflection of their learning process. Here, difficulties may arise when learners have *incompatible working methods*, for example concerning which regulation strategies and approaches the group should use to engage with the learning content (e.g., Järvenoja et al., 2013). Also, if students are dissatisfied with the *distribution of work load* or believe it to be *unfair*, this perception may negatively impact the learning progress (e.g., Koivuniemi et al., 2017). Also, learners may experience *procedural unfairness* when single group members dominate discussions on how the group should proceed or dictate the workflow. This way, the other group members cannot express their views on an equal footing, which might make them feel like they are not allowed to state their views (e.g., Järvenoja et al., 2013).

Incompatibility can also cause problems on an *emotional* level. A problem is considered as emotional if the problem is defined through interpersonal and relationship-related differences that can influence the interaction between group members (Näykki et al., 2014). For example, learners may have *communication problems* and have difficulties to understand the explanations of their peers (e.g., Järvenoja et al., 2013). This may cause anger and frustration (Näykki et al., 2014). Also, communication problems may appear when group members communicate unproductively. They can also occur when different interaction styles make the exchange within the group difficult. Also, groups may develop a *poor relationship quality* and perceive an interpersonal tension within their group, which, in turn, can result in an unpleasant group atmosphere and a lack of trust between the members (e.g., Järvenoja et al., 2013), which has been shown to impede learning (Ennen et al., 2015).

Finally, at the *motivational level,* difficulties may arise when learners have *different (incompatible) goals* for their collaboration. First, different goals may hinder the organization of the learning process. Näykki et al. (2014), for instance, asked participants to work in groups for about 12 weeks. After that, the learners had to report problems they experienced during the collaboration. Not only did all groups have different learning goals, but one specific learner, for instance, stated that his group had difficulties to coordinate because one part of the group was more interested in practice-oriented content, while other group members preferred to expand their theoretical knowledge. Second, different goals may lead to different levels and kinds of engagement. If one learner has the goal to expand their competences through the learning session and another group member wants to get the job done with as little effort as possible, the first student is likely more motivated than the second student to invest into the learning session (e. g., Dweck, 1986; Elliot, 1999; Elliot & Hulleman, 2017). For this reason, the group may have a difficult time deciding on their priorities as a group.

2.2. Regulation strategies in collaborative learning

Once groups encounter a regulation problem, they optimally try to regulate it (e.g., Järvelä et al., 2016, 2019), be it at the self-level (i.e., a single learner regulates their own problem), the co-level (i.e., a learner tries to regulate their peer's learning), or at the socially shared level (i.e., the group members jointly regulate the problem; see Hadwin et al., 2018). At any of these levels, a successful regulation is contingent upon the selection of appropriate regulation strategies. Based on Friedrich and Mandl (1992), Engelschalk et al. (2015), and Melzner et al. (2020) and Winne and Hadwin (1998) regulation strategies can be defined as all control actions of the learning process that are used to resolve a discrepancy between the current situation and the aimed standard (=problem). Melzner et al. (2020) differentiate between four clusters of regulation strategies that groups can choose from during collaboration: cognitive, metacognitive, motivational, and resource-oriented non--motivational strategies:

Cognitive regulation strategies contain all actions that directly address the way the group processes information (Nückles, 2017). They include *organizational strategies* (e.g., „jointly creating a mind map to structure the topic"), elaboration strategies such as *strategies for improving comprehension* (e.g., "explain the learning context to each other"), *strategies for closing gaps in prior knowledge* ("Mutual assistance if (sufficient) prior knowledge did not exist"), and *surface-oriented and retention strategies* ("Re-reading the text", Friedrich & Mandl, 1992).

Metacognitive regulation strategies are "operations of procedures learners use to regulate their learning" (Wenden, 1998, p. 302). They include joint *planning strategies* (e.g., "Negotiating on what should be achieved with the group work", Borge et al., 2018), *regulation strategies* (e.g., "Keeping track of the learning progress of the group", Molenaar et al., 2014), as well as *reflection and evaluation regulation strategies* (e.g., "Judging the quality of their ideas", Molenaar et al., 2014; Schreblowski & Hasselhorn, 2006).

Resource-related motivational regulation strategies are intended to increase the group's motivation to engage in learning (Wolters, 2003). Based on Schwinger et al. (2007, 2009), Melzner et al. (2020) and Wolters (1999) it is possible to differentiate between nine motivational regulation strategies that can be categorized into four groups: (1) External-value motivational regulation strategies use consequences as motivator for learning, such as *reward strategies* (e.g., "Doing something fun together after studying"), *strategies to declare successful self-control as a goal* (e.g., "Pulling ourselves together"), as well as *strategies to highlight frame conditions or constraints as motivator* (e.g. "Making the others aware of how much more material there is to learn and how close the exam is").

Further, they include regulation *strategies to increase the personal significance of the learning material* (e.g., "Reminding oneself/others/the group as a whole that the learning content has great relevance for the job/-desired profession") as well as *performance-self-talk* (when learners' remind themselves of their goal to achieve a good or to avoid a poor performance). (2) *internal-value motivational strategies* aim to expand the interest in and the fun of the learning session. They contain regulation *strategies to increase situational interest* (e.g., "Making the learning process or subject matter more fun, exciting, or interesting by exchanging interesting examples"), and *mastery goal-related-self-talk* (e.g. "Pointing out that the learning session is an opportunity to develop and grow own competencies"). (3) *Expectancy-related motivational regulation strategies* increase the expectancy of learners to achieve the desired goal. They include *ability-related regulation strategies* to strengthen the self-efficacy of the team members, for instance, by pointing out what they already achieved (Järvelä et al., 2008). Finally, regulators that use (4) socially *motivational regulation strategies* can highlight *group utility as a goal* (e.g., "Students who convince themselves to work because they do not want the other group members suffer due to their lack of preparation" or attempt to *manage emotional contagion* within the group by trying to catch up with the positive spirit of other group members or by trying to avoid dragging others down.

Resource-oriented, non-motivational regulation strategies, finally, focus on generating or maintaining internal or external learning resources. They include regulation strategies to *manage and share knowledge and information* regarding the learning material (e.g., "Sharing a document with all group members"), efficient and effective *use of time* ("e.g., "Planning pauses"), and *environmental control strategies* to manage the surrounding conditions (e.g., "Turning off all mobile phones"; e.g., Melzner et al., 2020; Wild & Schiefele, 1994), or *reaching out to external resources*, such as books or the internet. Students might also use technical regulation strategies, for instance when they revert to *alternative tools to carry out the group work*. Technical regulation strategies can also address internal resources such as their technical competences, for instance, when learners use *regulation strategies that rely on their technical knowledge* for a successful application of the work equipment or *regulation strategies for acquiring the required technical knowledge or understanding*. Other regulation strategies focus on *attention* and *effort management*, as well as attempts *to foster a social climate* within the group.

2.3. Problem-strategy-fit in prior research on collaborative learning

Prior literature developed the idea that, to be effective, regulation strategies need to "fit" the current regulation problems (e.g., Eckerlein et al., 2022). Dang et al. (2024) and Järvenoja et al. (2015), for example, argue for a situation-specific perspective on regulation, according to which successful regulation is always situation-specific. According to them, "learners [should] adapt their regulation to the challenges that are specific to the time and social context" (p. 216). However, it remains unclear based on which aspect of the problem learners should select regulation strategies. Here, many criteria are conceivable, such as the intensity of the problem, the social level at which it arises, or the specific type of the problem (e.g., Hadwin et al., 2018; Melzner et al., 2020).

Similarly, in their "socially shared regulated learning model", Hadwin et al. (2018) emphasize that "regulation involves adaptively responding to new challenges, situations or failure, thereby optimizing personal progress and standard" (p. 85). For example, they argue that in case of low self-efficacy (a motivational problem), learners should enact ability-related self-talk (a motivational regulation strategy), while to regulate procrastination (again a motivational problem), they recommend using a planning strategy ("setting goals"). Therefore, for Hadwin et al. (2018), the type of problem is an important factor for the decision which regulation strategies learners should use.

Boekaerts (1999) does not explicitly state that the regulation strategy should be chosen based on the problem. Instead, her self-regulation model differentiates between three layers of learning and regulatory activities. The inner layer represents all cognitive strategies that focus on information processing activities. The second layer contains all metacognitive strategies such as planning, monitoring, and evaluating the use of these cognitive strategies of the inner layer. The third layer addresses the goals and resources needed to pursue those goals. This layer encompasses motivational and other resource-oriented regulation strategies. Nonetheless, she indicates that learners should choose a regulation strategy that solves the problem they are currently facing, again reflecting the view that different regulation strategies should be applied for different regulation problems. Yet, also in this model, the question of what specific regulation strategies to use in the light of what problem, remains unanswered.

Besides such theoretical considerations, several researchers have approached problem-strategy-fit from an empirical point of view. Engelschalk et al. (2015), for instance, asked students what regulation strategies they would use for different, pre-selected motivational problems and how well they are able to motivate themselves in these situations. Results indicated that learners select different regulation strategies depending on whether they perceive the learning situation as boring or as too difficult (Engelschalk et al., 2015). These results are in line with findings from a study by Koivuniemi et al. (2018): They had teacher education students collaborate and interviewed them after the collaboration. In these interviews, participants had to describe three challenging situations from their collaborative learning session: one cognitive problem, one motivational problem, and one resource-oriented problem. Next, participants were prompted to describe how they tried to regulate these challenges. Results indicated that the learners used different regulation strategies for the different problem types. Similar results were reported by Bakhtiar and Hadwin (2020) as well as Malmberg et al. (2015).

Consequently, the use of different regulation strategies for different regulation problems seems to be an important aspect of a successful regulation process. However, prior research mostly focused on a limited set of regulation strategies (e.g., only motivational regulation strategies, as in Engelschalk et al., 2015). Also, little is known on *how* to decide which regulation strategy fits which problem in collaborative learning. More importantly, though, the general idea of "problem-strategy-fit" still appears to be vague at a theoretical level – from prior research, the dominating idea seems to be that a regulation strategy can be classified as fitting if it somehow helps alleviate a current regulation problem. Yet, this can only be determined post hoc, that is after its effects in a specific situation are known. For educators and researchers, it would however be helpful to theoretically determine a priori which regulation strategy fits which problem, so that specific problem-strategy combinations could be investigated and trained in a targeted manner. From our perspective, this can be reached by applying the immediacy of strategy use concept we elaborate on in this article.

2.4. Immediacy of strategy use as an alternative to prior approaches to conceptualize problem-strategy-fit in collaborative learning

In order to arrive at a clearer idea on what kinds of regulation strategies are suitable for what kinds of regulation problems during collaborative learning, we have proposed the "*immediacy of strategy use*" concept (Melzner et al., 2020). According to this concept, a regulation strategy is *immediate* to a specific problem when it can *solve the respective problem directly without intervening steps* (e.g., without the use of further regulation strategies), at least if it is well-executed. For example, if students recognize that their group lacks procedural fairness because single group members dominate the decision process, they might redistribute responsibilities to make sure that each person oversees part of the group work. This regulation strategy can be considered an immediate regulation strategy because it directly addresses the core of the problem (Lack of Procedural Fairness) and, if well-executed, will solve it without additional regulation strategies being necessary. In comparison, a non-immediate regulation strategy for the regulation of this problem

would be if group members motivate each other to continue working by rewarding themselves (e.g., going out for ice cream later). This regulation strategy might generally help the learners to acquire knowledge because the group would continue to study despite the friction caused by the lack of fairness. However, it cannot be considered an *immediate* regulation strategy because the actual problem—the lack of procedural fairness—would not be solved solely on the grounds of this regulation strategy.

From our perspective, the immediacy concept provides several advancements compared to prior literature, as it provides a clear criterion for when to apply what kind of regulation strategy. This stands in contrast with the vague idea of "problem-strategy-fit" that has been advocated in the regulation models of described above, according to which a "fitting" strategy could only be identified through empirical evidence, and every problem-strategy-combination would have to be tested. Also, the vague "problem-strategy-fit" notion leaves educators with difficulty in how to instruct and support learners during their regulation process. The immediacy concept, in turn, addresses these issues, adds to the theory and helps to theoretically determine a priori which regulation strategy fits which regulation problem.

In a first attempt to use the immediacy of strategy use concept in empirical research, Melzner et al. (2020) obtained evidence for the criterion validity of the immediacy concept. They investigated self-organized study groups who prepared for an important exam together. After each group learning session, each group member answered an online questionnaire that asked for their satisfaction with the group learning process, the biggest problem they experienced during the respective study session, as well as the regulation strategies they used to overcome the biggest problem. Prior to this, the authors had established which regulation strategies could be considered immediate for each problem based on the theoretical considerations described above to operationalize immediacy. Results indicated that the use of regulation strategies classified as immediate were predictive for students' satisfaction with their group's learning processes. Taken together, at least the results of Melzner et al. (2020) yield first evidence for the criterion validity of the immediacy of strategy use concept. Still missing, however, is evidence to judge its content validity.

2.5. Using expert ratings to validate immediacy of strategy use

In order to yield evidence regarding the content validity of the immediacy of strategy use concept, the present study uses an expert study approach. That is, we asked experts from the field of learning research on regulation and collaborative learning to rate which regulation strategies they would regard as immediate for what kinds of regulation problems. Expert ratings are an established method in many different areas of research on learning and teaching (e.g., for learning from errors: Pfost & Hübner, 2024; peer feedback: Hovardas et al., 2014; professional vision: Gold & Holodynski, 2017). Also, using expert ratings to determine the fit of regulation strategies for different kinds of regulation problems is not new: In a series of studies, Bäulke et al. (2018), Eckerlein et al. (2022), and Steuer et al. (2019) addressed the question which kind of motivational regulation strategies "fit" which motivational problem, and asked experts from the field to rate the "usefulness" of different motivational regulation strategies for different motivational problems. Further research also used expert ratings to investigate problem-strategy-fit for other sets of problems. For example, Artelt et al. (2009) asked 68 reading experts to rate the effectiveness of different reading strategies in different learning situations. Next, the authors compared the order of the experts' ratings to determine their agreement by pair-comparisons. Experts reached a higher level of agreement if they ranked two reading strategies similarly, such as when both authors considered reading strategy "A" to be more effective than reading strategy "B". For resource-related problems, a similar study was conducted by Waldeyer et al. (2019).

Based on the positive experiences with expert study approaches in the studies previously mentioned, we decided to run an expert study to determine the content validity of the immediacy of strategy use concept in the context of collaborative learning. If the concept proves to be valid, this would yield a clearer theoretical understanding of what kinds of regulation strategies learners should use to regulate what kinds of regulation problems during collaboration and help educators and learners to decide a priori on what regulation strategies to use resp. to apply for what problem.

2.6. Research questions

This study aims to yield empirical evidence regarding the content validity of the immediacy of strategy use concept in collaborative learning. Our first research question was.

1. Which specific regulation strategies do experts from the fields of research on regulation and collaborative learning concordantly consider immediate to solve different types of regulation problems during collaborative learning (RQ1)?

In line with prior findings, which indicate that successful learners use a variety of different regulation strategies over the course of a learning session with different situations (Bakhtiar & Hadwin, 2020; Malmberg et al., 2015) or with respect to different challenges (Engelschalk et al., 2015), we assume that experts will rate different regulation strategies as highly immediately effective for different regulation problems. In addition, we assume that with the concept of immediacy of strategy use, experts will identify at least one regulation strategy as "very much" immediately effective with a high agreement for each of the regulation problems.

Our second, more exploratory research question was.

2. To what extent do experts from the field of learning research on regulation and collaborative learning agree on how immediate specific regulation strategies are for different kinds of regulation problems (RQ2)?

On the one hand, one might argue that experts possess vast knowledge about regulation problems as well as regulation strategies and will consequently more or less share the same views on the immediacy of specific regulation strategies for a certain regulation problem. Therefore, we assume that experts are able to at least somewhat agree on the immediacy of most of the regulation strategies for the majority of regulation problems.

On the other hand, prior research on the effectiveness of regulation strategies in areas other than collaborative learning indicates that the agreement between experts may vary depending in areas other than collaborative learning indicates that the agreement between experts may vary depending on the specific kind of regulation problem and learning situation (see Artelt et al., 2009; Steuer et al., 2019; Waldeyer et al., 2019). We thus expect a varying agreement, too, at least for a substantial subset of problem-strategy-combinations.

With our third research question, we investigated.

3. Can we, based on the immediacy rating and the agreement of immediacy from the experts, clearly differentiate between immediate and non-immediate regulation strategies for each specific regulation problem (RQ3)?

Based on the regulation theories described above (e.g., Boekaerts, 1999; Hadwin et al., 2018), different regulation strategies have different functions for different problems. Therefore, we hypothesize that experts can differentiate between at least two types of regulation strategy categories for each kind of regulation problem: immediate and non-immediate strategies. Since, according to the immediacy concept, regulation strategies either address the core of the problem or they do

not (Melzner et al., 2020), we also assume that in line with prior approaches such Cooper and Corpus (2009), and contrary to other previous studies regrading fit (e.g. Eckerlein et al., 2022), we will not find many categories of regulation strategies that are only *somewhat* immediately effective.

3. Material and methods

To answer our research questions, we recruited potential experts to judge the immediacy of different regulation strategies for different regulation problems (see 3.1 Sample). Next, we presented them our idea of immediacy and used a definition and an example to illustrate the concept (see 3.2 Procedure). Afterwards, participants were asked to familiarize themselves with the different regulation strategy types we used in our study. Finally, they rated the immediacy of 27 regulation strategy types for eight regulation problems. For each regulation problem, the participants were given the name of the regulation problem (see 3.3 Immediacy ratings) as well as three example statements of situations in which the regulation problem could occur. We calculated the mean of the immediacy ratings and the agreement of the experts to analyze the data (3.4 Analysis method). The complete process is shown in Fig. 1.

3.1. Sample

The first challenge we faced was to identify and recruit possible experts for our study. Therefore, we sent an e-mail with a personalized cover letter to all authors and co-authors with a publicly accessible e-mail address who published at least one paper in at least one of the proceedings from 2019, 2017, 2015 and 2011 of the international conferences on Computer-Supported Collaborative Learning (CSCL). All participants reported to have published at least one peer-reviewed journal article in either the field of collaborative learning, self-regulation, or regulation in collaborative learning settings as first author, with $M = 3.86$ peer-reviewed journal articles about collaborative learning ($SD = 1.04$), $M = 1.85$ articles about self-regulated learning ($SD = 1.11$), and $M = 2.19$ articles on regulation in collaborative learning settings ($SD = 1.14$) on average. 56.90 % of the sample was female. Most participants were between 36 and 55 years old (66.10%), and none were below the age of 25. Experts were active in research for an average of $M = 17.05$ years (SD = 10.33). More than one fourth were employed as professors (25.45 %). Participants reported to already have published $M = 3.86$ peer-reviewed journal articles about collaborative learning ($SD = 1.04$), $M = 1.85$ articles about self-regulated learning ($SD = 1.11$), and $M = 2.19$ articles on regulation in collaborative learning settings in peer-reviewed journals or conference proceedings ($SD = 1.14$) on average.

3.2. Procedure

The online questionnaire first asked the participants to answer demographic items. Next, the experts found a short text that explained the concept of immediacy of strategy use in collaborative learning: “A strategy is immediately effective for a problem if the strategy is generally suitable for completely solving the problem”. Then, we used a comprehension-related problem (= unstructured learning material, see Table 1) as an example to illustrate the concept and presented the problem as well as one example of an immediate regulation strategy for the problem, and one example of a non-immediate regulation strategy (see Table 1).

On the next page, participants were informed that on the following pages they would be asked to rate to which extent different regulation strategies are immediately effective for different problems. We created an overview of all available 27 regulation strategy types, including a short definition of the regulation strategy along with three examples (e.g., “environmental control strategies (EC)” were described as “strategies aimed at managing one’s surrounding conditions in a way that fosters learning“, for instance, “Turning off all mobile phones”, “Changing location and looking for a quiet place” or “Letting some fresh air in”; see Table 2 and Fig. 2). The experts could access this overview in a separate browser window and were asked to familiarize themselves with the different regulation strategy types before moving on to the next page, but to keep the separate browser window open in case they wanted to revisit the regulation strategies again.

After that, participants were presented with the eight regulation problems described in section 2.1. For each regulation problem, we first presented its label, followed by three exemplary statements based on Greisel et al. (2021) to illustrate the regulation problem (for one exemplary statement see Table 3).

Below each problem statements (and on the same page), participants rated 27 regulation strategy types regarding their immediacy for the

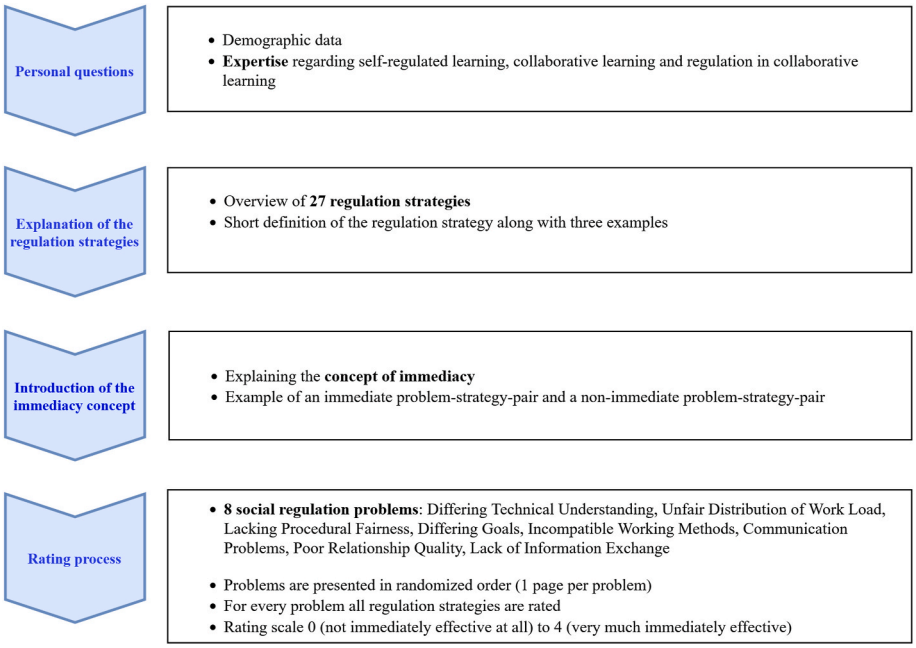

Fig. 1. Overview of the method.

Table 1
Example for an immediate problem-strategy-pair and a non-immediate problem-strategy-pair.

Problem: Unstructured learning material consisting of a large number of unconnected individual texts which do not seem to have any common thread.
Immediate strategy: Structuring the learning material through bringing it into a new overview, sorting technical terms by topics, and creating summaries.
In comparison a non-immediate, yet helpful strategy would be: Group members motivate each other to continue working by offering a reward (e.g., going out for an ice cream later). This might be generally helpful because the group would continue to study with the help of the learning material, but it cannot be considered as an immediate strategy because the actual problem—the lack of structure of the learning content—would not be solved.

Table 2
Overview over the included regulation strategies.

Strategy	Example
Cognitive regulation strategies:	
Organizational strategies (OS)	"Writing a summary"
Strategies for improving comprehension (SIC)	"Explaining the learning content"
Strategies for closing gaps in prior knowledge (CGP)	"Mutual assistance if (sufficient) prior knowledge did not exist"
Strategies to resolve differences in understanding (RDU)	"Justifying one's conception of the task"
Surface-oriented and retention strategies (SRS)	"Reading the text"
Metacognitive regulation strategies:	
Planning and regulation of the learning process (PRL)	"Sharing suggestions with other group members concerning the procedure"
Reflection and evaluation of the learning outcomes (REO)	"Giving Feedback (on the work of other group members)"
Motivational regulation strategies:	
Reward strategies (RS)	"Doing something fun together after learning"
Increasing situational interest (SIT)	"Use of interesting/diversified learning methods"
Increasing personal significance (IPS)	"Visualization of possible fields of application concerning the learning content"
Mastery and performance-related self-talk (approach and avoidance) (MPS)	"Telling yourself that you don't want to be the weakest performing member of the group concerning the exam"
Ability-related self-talk (AST)	"Reminding oneself/others/the group as a whole of previous successes (in a similar situation/subject)"
Declaring successful self-control as a goal (DSG)	"Pulling yourself together"
Highlighting frame conditions or constraints (HFC)	"Making the others aware of how much more material there is to learn and how close the exam is"
Highlighting group utility as a goal (HUG)	"I do not want others to suffer from my lack of preparation."
Management of emotional contagion (MEC)	"Pretending not to be annoyed by the learning content"
Unspecific motivation strategies (UMS)	"Motivating others"
Resource-oriented regulation strategies:	
Time management and coordination (TMC)	"Arranging an additional date in advance"
Environment control (EC)	"Letting some fresh air in"
Knowledge and information management (KIM)	"Creating a literature list"
Attention management (AM)	"Drinking something to increase ability to concentrate"
Effort management (EM)	"Distributing responsibilities"
External resource management (ERM)	"Asking the teaching assistant for help"
Fostering a positive social climate (FSA)	"Integrating excluded group members"
Use of alternative tools (UAT)	"Using an alternative software"
Resource to technical knowledge for handling work equipment (RTK)	"Switching devices off and on again"
Acquisition of technical knowledge (ATK)	"Getting familiar with the software"

regulation problem ("Please assess now to what extent the following regulation strategies can be considered immediately effective with regard to this problem", see Fig. 2). After completion, participants could move on to the next regulation problem on the next page. Due to the large number of items, participants were explicitly allowed to stop participating at any time but were asked to assess as many regulation problems as possible. We presented the regulation problems in a randomized order to exclude sequential effects, and to make sure we would end up with a considerably large number of ratings for each problem-strategy-combination.

3.3. Immediacy ratings

Next, participants were asked to assess the immediacy of 27 regulation strategies for the eight regulation problems. Based on previous work such as Engelschalk et al. (2015), Mandl and Friedrich (2006), and Melzner et al. (2020), and as described in section 2.2, we differentiated between 27 regulation strategies that were categorized into four groups (i.e., five cognitive, two metacognitive, ten motivational, and ten non-motivational resource-oriented regulation strategies). Each of these 27 regulation strategies was presented to the experts with a short definition and three examples (see Table 2). This information was accessible on a separate webpage at any time and could be accessed via hyperlink. Participants rated the immediacy of each regulation strategy for the given regulation problem on a scale from 0 = *not immediately effective at all* to 4 = *very much immediately effective* by moving a slider (see Fig. 2). For each regulation problem, all regulation strategies were presented on the same page, and for every strategy, the slider was pre-set to 0 and could be locked in five different positions (for each of the 5 scale points). Only the extreme scale points (0 = *not immediately effective at all* and 4 = *very much immediately effective*) were labelled. We calculated the mean of all experts' immediacy ratings for each single problem-strategy-combination to determine the overall immediacy of a certain regulation strategy for a specific regulation problem. If the participant who looked at the respective regulation problem did not move any slider on the page, we recoded all items on this page as missing values, as it was likely that the participant would have stopped working on the questionnaire on that page (i.e., values of 0 would be more likely to indicate missing values than ratings of non-immediacy).

3.4. Analysis method

Since we were interested in immediate (rather than non-immediate) regulation, we mostly focused on problem-strategy-pairs that at least half of the experts rated higher than 0 = not immediately effective at all (problem-strategy-pairs with a median of 1 or greater). For this reason, only participants who rated the regulation strategy with at least 1 were included in the analysis of our research questions with respect to those problem-strategy-pairs.

For the "immediacy of strategies" we averaged the mean immediacy ratings across the experts for each problem-strategy-pair and differentiated between three levels of immediacy by classifying all regulation strategies below the theoretical value of 2 as "somewhat" immediately effective, regulation strategies with a value of at least 2 and below the

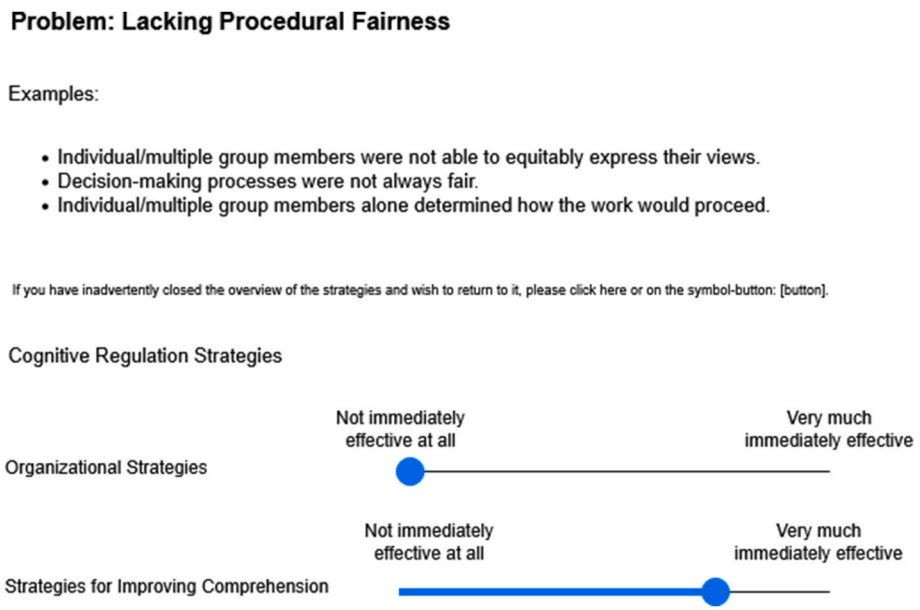

Fig. 2. Example for a page from the questionnaire that captured experts' immediacy ratings of regulation strategies for a particular regulation problem.

Table 3
Overview of all included regulation problems with one example statement each.

Problem	Example
Differing Technical Understanding	Single/multiple group members have interpreted technical terms differently.
Unfair Distribution of Work Load	Single/multiple group members were dissatisfied with the distribution of work.
Lacking Procedural Fairness	Single/multiple group members could not express their views on an equal footing.
Differing Goals	Single/multiple group members had goals for group work that were difficult to reconcile.
Incompatible Working Methods	Single/multiple group members had incompatible working methods.
Communication Problems	Single/multiple group members communicated ineffectively during group work.
Poor Relationship Quality	Between single/multiple group members, there was an uncomfortable atmosphere.
Lack of Information Exchange	Single/multiple group members worked on the topic only alone for themselves.

value of 3 as "moderately" immediately effective, and regulation strategies with a value of at least 3 as "very much" immediately effective. Additionally, we calculated Within-Subject-Friedman-Tests for the four regulation strategies that were considered "very much" immediately effective with a high agreement between experts at least once for one of the eight regulation problems. By this, we wanted to test whether expert immediacy ratings of these regulation strategies differed significantly between the regulation problems. If the immediacy ratings of a specific regulation strategy vary significantly from regulation problem to regulation problem, this will support our assumption that experts regard a problem-specific use of that strategy as necessary.

We calculated the agreement between experts' immediacy ratings for each strategy-problem-combination separately (see also Eckerlein et al., 2022; Lüdtke et al., 2006). For this purpose, we used the rWG (James et al., 1993). This indicator examines how similar participants rate an item (Lüdtke et al., 2006). Perfect agreement is indicated by a rWG of 1. If, for instance, ten participants rate an item on a Likert scale from 1 to 4 with the same value (e.g., "3"), then they would reach this perfect agreement. A rWG of 0 would indicate that the participants rated the item equally frequently with the values 1, 2, 3 and 4. This would equal random ratings. Therefore, a rWG below 0 would show that the participants were less concurring in their rating than could be expected by chance (Lüdtke et al., 2006). This should be the case when participants decidedly disagree on an item. More specifically, the rWG is calculated by the variance of the ratings between experts divided by the variance that would result from an evenly distributed expert rating. In order to visualize the different regulation strategy categories, we plotted experts' average immediacy ratings against their agreement for each regulation problem. Next, we differentiated three degrees of agreement and defined the 3rd quantile as cut-off value to indicate a high agreement. All rWG values lower than 0 were considered low interrater agreement.

Concerning RQ3, we explored the different categories of regulation strategies for each regulation problem with eight hierarchical cluster analyses (one cluster analysis for each problem) using Ward's method (Ward, 1963) and the Euclidean distance measure. These cluster analyses included (a) the z-standardized average immediacy rating of the regulation strategy and b) the z-standardized rWG-values as a measure of agreement. We used the gap statistics and a dendrogram to determine the number of clusters for each regulation problem. If our assumptions are correct, we should find different clusters of regulation strategies for each regulation problem, depending on the participants' immediacy ratings and their (dis-)agreements.

We used R for all our analyses (RStudio Team, 2022).

4. Results

4.1. Immediacy ratings for different kinds of regulation problems (RQ1)

With regard to RQ1 we investigated which specific regulation strategies concordantly consider immediate to solve different types of regulation problem. In order to answer this question, we examined the mean of the immediacy ratings of each regulation strategy for each regulation problem (see Table 4).

However, the mean of the immediacy ratings from the experts alone can still be a product based of varying different ratings from different experts, even if the average immediacy rating is high. For instance, if a regulation strategy would be rated by four different experts as "somewhat" immediately effective (2), "moderately" immediately effective (3), "very much" immediately effective (4) and "very much" immediately effective (4), the average immediacy rating would be above 3 and strategy would then be classified as "very much" immediately effective, although half of the respective experts would not agree with this statement.

Table 4
Experts' immediacy rating of regulation strategies for regulation problems in collaborative learning settings.

Problems	OS[a]	SIC	CGP	RDU	SRS	PRL	REO	RS	SIT	IPS	MPS	AST	DSG	HFC	HUG	MEC	UMS	TMC	EC	KIM	AM	EM	ERM	FSA	UAT	RTK	ATK
Unfair Distribution of Work Load ($n = 20$)	0.85	0.15	0.15	0.65	0.05	2.88	1.00	0.50	0.45	0.75	0.35	0.15	0.45	0.60	2.79	0.75	0.40	2.43	0.55	0.85	0.30	2.58	0.30	2.57	0.30	0.25	0.25
Lacking Procedural Fairness ($n = 20$)	0.70	0.25	0.20	1.00	0.05	2.76	1.25	0.65	0.35	0.40	0.55	0.30	0.55	0.75	3.25	1.25	0.80	1.20	0.50	1.00	0.85	3.30	0.35	3.00	0.15	0.10	0.10
Differing Technical Understanding ($n = 23$)	2.42	2.69	2.21	3.53	0.43	0.96	0.61	0.22	0.30	0.39	0.17	0.35	0.26	0.30	1.22	0.74	0.48	0.74	0.48	1.09	0.65	0.39	0.87	0.91	0.57	1.13	1.17
Differing Goals ($n = 24$)	1.08	0.50	0.46	3.14	0.17	2.83	2.21	0.58	0.75	1.04	0.71	0.54	0.83	2.24	3.11	2.29	0.75	2.00	0.67	0.92	0.50	0.96	0.63	2.71	0.33	0.21	0.21
Incompatible Working Methods ($n = 21$)	0.67	0.76	0.43	2.75	0.24	3.05	2.69	0.57	0.48	0.86	0.29	0.52	0.48	0.62	3.31	0.90	0.57	1.00	0.48	1.05	0.81	2.55	0.71	2.75	0.48	0.43	0.43
Communication Problems ($n = 23$)	0.70	0.48	0.57	2.31	0.13	2.94	2.53	0.48	0.57	0.43	0.26	0.26	0.57	0.74	2.84	1.04	0.96	2.77	0.87	1.17	0.78	0.70	0.87	3.36	0.61	0.52	0.65
Poor Relationship Quality ($n = 23$)	0.43	0.22	0.17	1.00	0.17	2.17	0.43	0.83	2.17	1.00	0.39	0.43	0.87	0.48	3.25	2.63	0.83	0.43	0.57	0.26	0.74	1.04	0.52	3.63	0.35	0.17	0.13
Lack of Information Exchange ($n = 22$)	0.95	0.55	0.50	1.09	0.09	2.67	2.33	1.23	0.50	0.64	0.45	0.32	0.32	0.55	3.50	1.09	0.50	0.86	0.32	2.62	0.64	2.58	0.32	3.33	0.23	0.18	0.18

[a] For explanation of abbreviated regulation strategies see Table 2.

For this reason, with respect to RQ 1, we inspected the combination of immediacy ratings and agreement between experts and analyzed for each regulation problem whether at least one regulation strategy rated as "very much" immediately effective was highly agreed on and which regulation strategies were considered as immediately effective. For six regulation problems (see Fig. 3), experts rated at least one regulation strategy as "very much" immediately effective with a high agreement. The exceptions were "Incompatible Working Methods" and "Unfair Distribution of Workload".

Regarding the types of regulation strategies, we found that experts rated different regulation strategies as "very much" immediately effective for different regulation problems. For instance, experts strongly agreed that the strategy *fostering a social climate* will, if well-executed, solve "Communication Problems" as well as "Poor Relationship Quality". Some experts also believed that this regulation strategy immediately tackles a "Lack of Information Exchange". According to experts, however, this regulation strategy did not immediately address a "Differing Technical Understanding". Instead, participants believed that "Strategies to resolve differences in understanding" were a more immediate fit for that regulation problem.

We further tested the assumption that particular strategies would be differentially immediate for different regulation problems with Friedman tests. Therefore, we looked at all regulation strategies that on average had both a high immediacy rating and a high agreement (so all regulation strategies that were located in the upper right square in Fig. 3). This was the case at least once for four regulation strategies. For all four regulation strategies, we found significant differences in immediacy across regulation problems (strategies to resolve differences in understanding: $\chi^2(7) = 21.512$, $p = 0.00$, strategies to highlight group utility as a goal: $\chi^2(7) = 19.143$, $p = 0.01$, strategies to foster a positive social climate: $\chi^2(7) = 32.607$, $p = 0.00$, effort management strategies: $\chi^2(7) = 18.904$, $p = 0.01$). Hence, experts clearly saw different regulation strategies as differently immediately effective to solve different regulation problems.

4.2. Between-expert agreement of immediacy ratings (RQ2)

With respect to RQ 2, we examined to what extent experts agreed on the immediacy of regulation strategies for the different kinds of regulation problems. As expected, experts agreed on the immediacy of the vast majority regulation strategies for all regulation problems to a higher degree than could be expected by chance (Lüdtke et al., 2006). For 25 percent of all problem-strategy-pairs shown in Fig. 3 experts even reached a high agreement. Simultaneously, for all but one regulation problem, experts disagreed on the immediacy rating of at least one regulation strategy that was considered to be at least "somewhat" immediately effective. In other words, for seven out of eight regulation problems, experts concurred less in their ratings for some regulation strategies than would be expected by chance (Lüdtke et al., 2006). However, the kinds of regulation strategies experts disagreed on varied by regulation problem. For instance, experts at least somewhat agreed that "Strategies to Resolve Differences in Understanding (RDU)" would be immediately effective to solve the regulation problem "Different Technical Understanding". At the same time, experts were unsure whether RDU would immediately approach "Communication Issues". "Lacking Procedural Fairness" was an exception to this pattern, since we did not find an at least "somewhat" immediately effective regulation strategy with a low agreement for this regulation problem at all.

Note: Agreement between experts: rWG-value by James et al. (1993). Expert ratings with a rWG-value >0 were considered ratings with a low agreement, and expert ratings with an rWG-value above the third quartile were considered ratings with a high agreement; Immediacy of strategies: mean of all experts' immediacy ratings with a rating≥1. *Cognitive*: Organizational Strategies (OS), Strategies for Improving Comprehension (SIC), Strategies for Closing Gaps in Prior Knowledge (CGP), Strategies to Resolve Differences in Understanding (RDU);

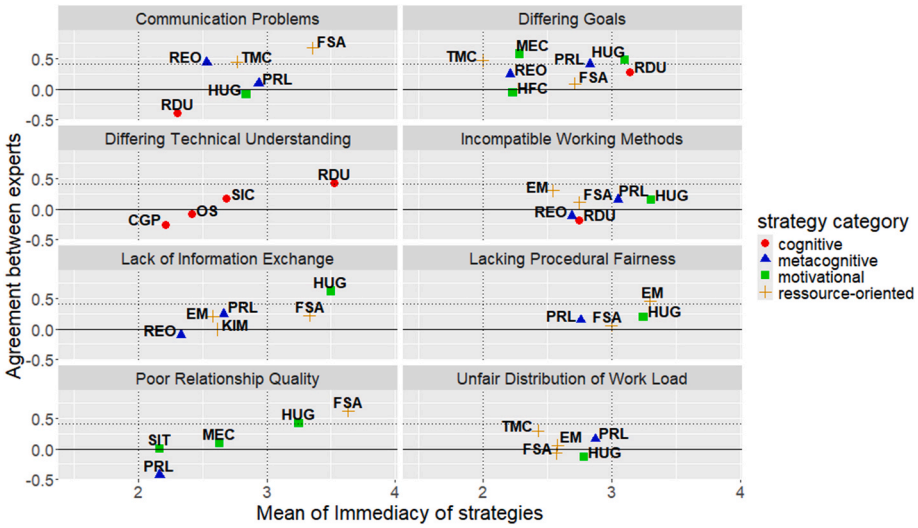

Fig. 3. Agreements between experts' immediacy ratings of regulation strategies for regulation problems in collaborative learning settings.

Metacognitive: Planning and Regulation of the Learning Process (PRL), Reflection and Evaluation of the Learning Outcomes (REO); *Motivational*: Increasing Situational Interest (SIT), Highlighting Group Utility as a Goal (HUG), Management of Emotional Contagion (MEC), Highlighting Frame Conditions or Constraints (HFC); *Resource-oriented*: Time Management and Coordination (TMC), Knowledge and Information Management (KIM), Effort Management (EM), Fostering a Positive Social Climate (FSA).

4.3. Strategy clusters for selected regulation problems (RQ3)

With respect to RQ3, we investigated if we, based on the immediacy rating and the agreement of immediacy, can differentiate between different categories of immediate and non-immediate regulation strategies for each problem. As expected, we found between two and five different clusters for each regulation problem (see Figs. 4–11). First, the most striking feature is that there is a clear gap between non-immediate strategies on the left and immediate strategies on the right. This is consistently true for all regulation problems. Second, the regulation strategies were arranged in a U-shape for most regulation problems. The upper left end of this U-Shape represents the category of regulation strategies that experts concordantly considered as "not immediately effective" at all for the particular regulation problem. We found this category for all regulation problems. Also, for all regulation problems, we could identify at least one category with regulation strategies that were considered as rather immediately effective (upper right corner). For none of the regulation problems, we found many regulation strategies in the theoretical middle of the immediacy scale (1–2).

For instance, the regulation problem "Poor Relationship Quality" had five regulation strategy clusters, one cluster with regulation strategies that experts agreed on as non-immediate such as "Strategies for Improving Comprehension" (SIC), and two clusters with also non-immediate regulation strategies with continuously decreasing agreement with regulation strategies such as "Reward Strategies" (RS). We also found two clusters with regulation strategies that were considered as rather and very much immediately effective with regulation strategies such as "Planning and Regulation of the Learning Process" (PRL, rather immediately effective) and "Fostering Social Climate" (FSA, very much immediately effective). Hence, based on the immediacy rating and agreement we can find different categories of regulation strategies for the problems that can be clearly classified as either an immediate regulation strategy category or a non-immediate regulation strategy category.

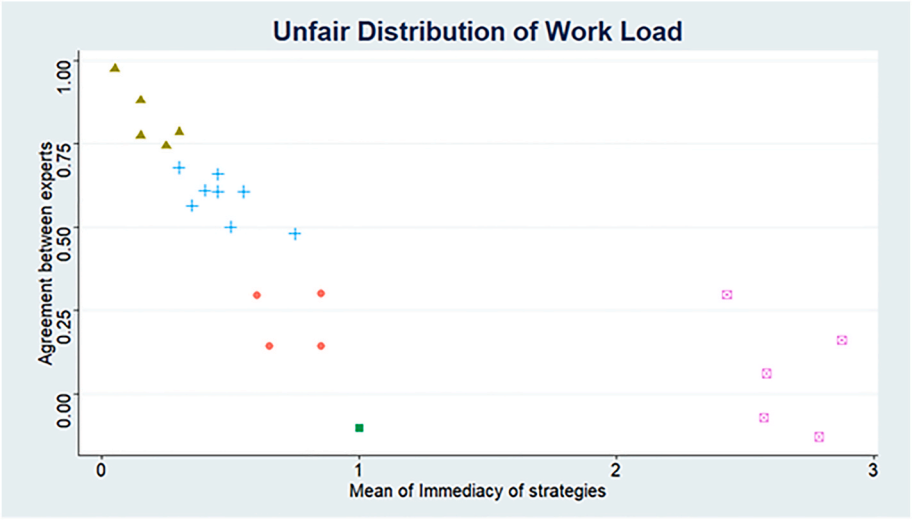

Fig. 4. Cluster analysis with agreement between experts and mean immediacy of strategies as indicator.

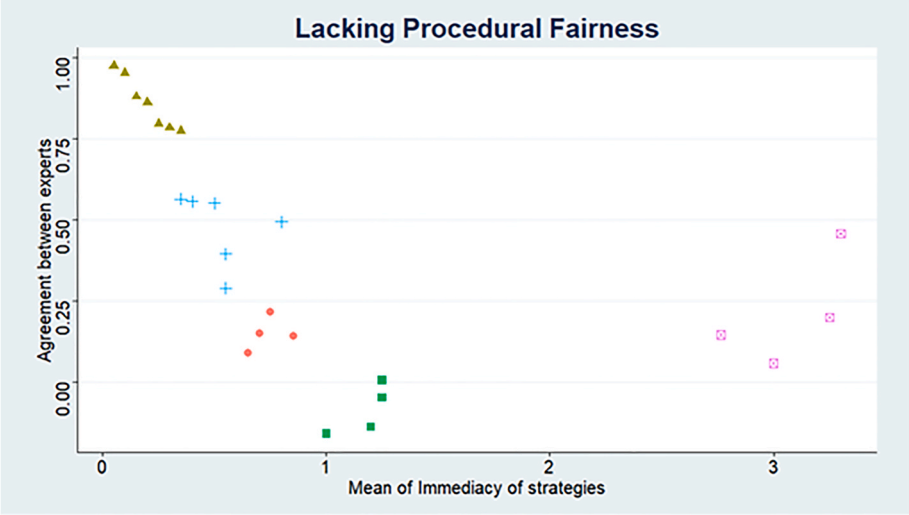

Fig. 5. Cluster analysis with agreement between experts and mean immediacy of strategies as indicator.

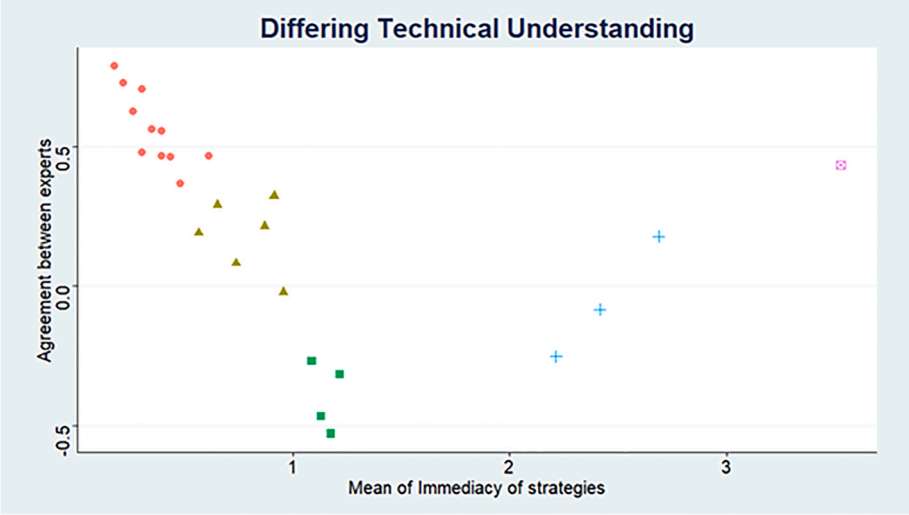

Fig. 6. Cluster analysis with agreement between experts and mean immediacy of strategies as indicator.

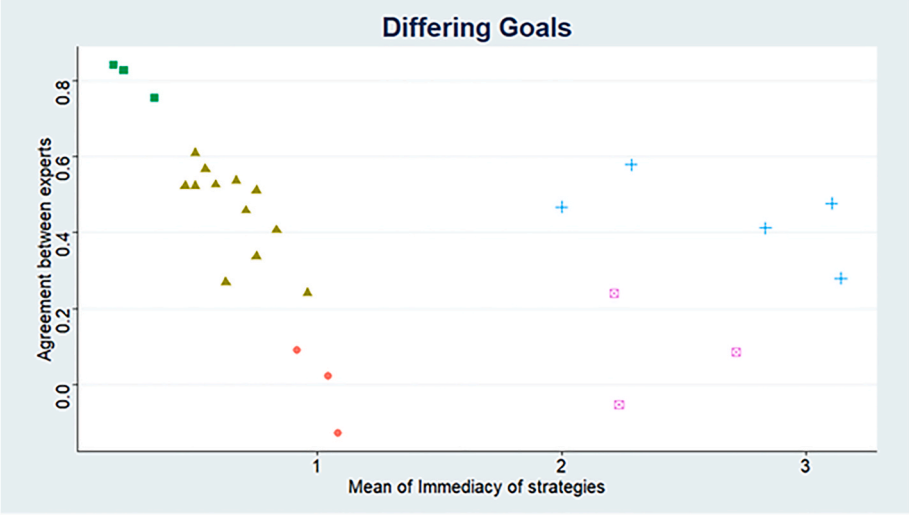

Fig. 7. Cluster analysis with agreement between experts and mean immediacy of strategies as indicator.

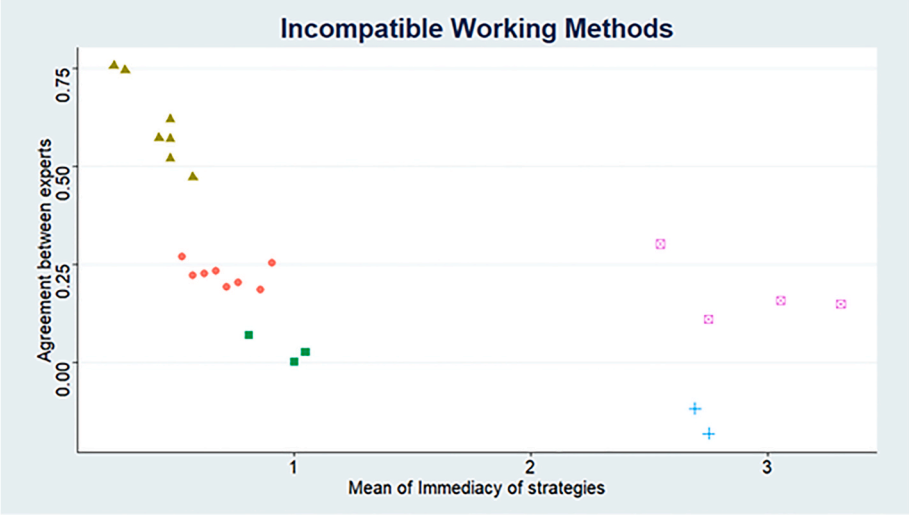

Fig. 8. Cluster analysis with agreement between experts and mean immediacy of strategies as indicator.

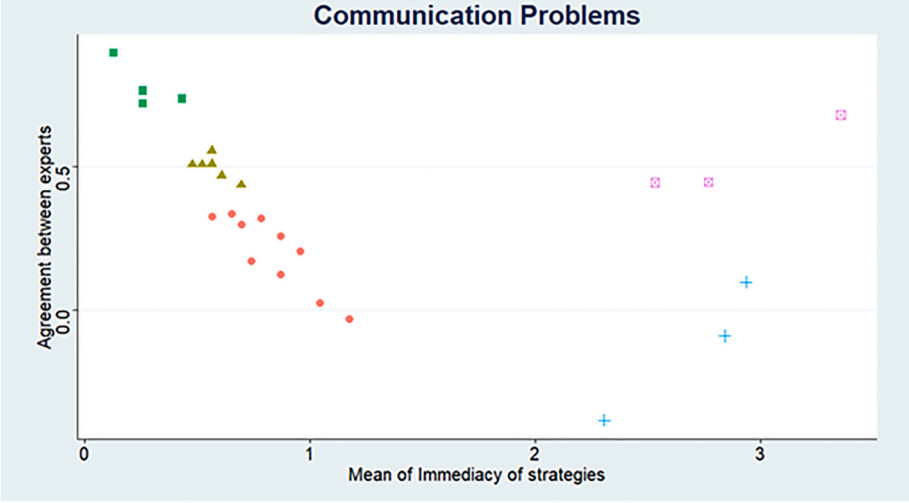

Fig. 9. Cluster analysis with agreement between experts and mean immediacy of strategies as indicator.

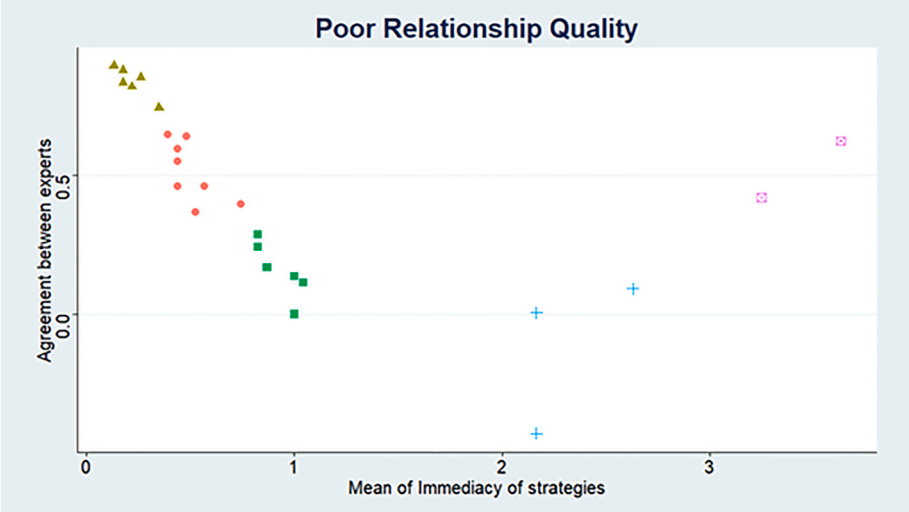

Fig. 10. Cluster analysis with agreement between experts and mean immediacy of strategies as indicator.

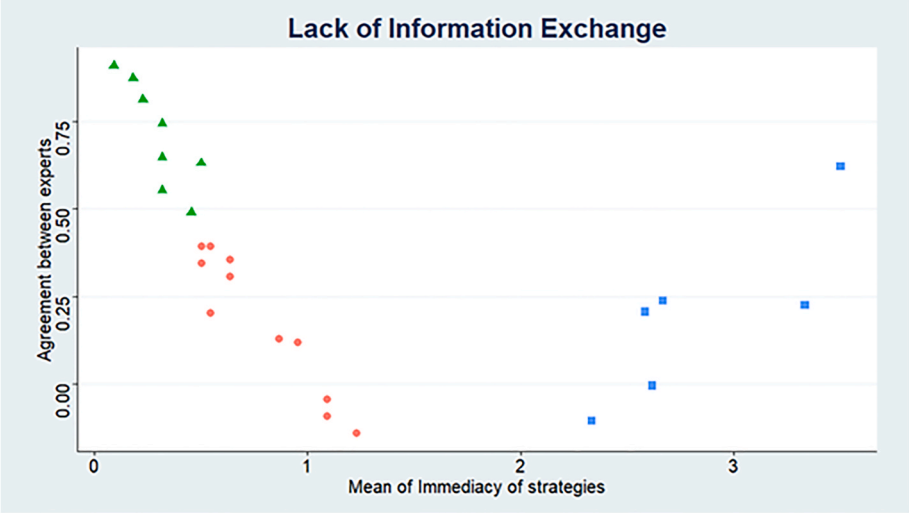

Fig. 11. Cluster analysis with agreement between experts and mean immediacy of strategies as indicator.

5. Discussion

Prior theories and findings indicated that a regulation strategy should fit the regulation problem it is meant to regulate (e.g., Bakhtiar & Hadwin, 2020). However, as we noted in the theoretical part of this article, the idea of "fit" remained rather vague in prior research, especially at a conceptual level. So far, it has not been depicted how educators and learners should decide which regulation strategies should be promoted resp. selected in which regulation problem situations. Therefore, we proposed the immediacy of strategy use concept to address this lack of a framework. The immediacy of strategy use concept posits that an *immediate strategy* is a regulation strategy that addresses the core of the regulation problem *directly without further intervening steps* (Melzner et al., 2020). Whereas Melzner et al. (2020) gathered first evidence for the criterion validity of the immediacy concept by showing empirically that students' use of immediate regulation strategies was associated with their satisfaction with the group regulation process in a real-life collaborative learning setting, however, evidence for the content validity of this concept was missing so far. The study presented in this article therefore asked experts from the field of (self-)regulated learning and collaborative learning research to rate the immediacy of 27 regulation strategies for eight regulation problems in order to gather empirical evidence for the content validity of the immediacy of strategy use concept in collaborative learning.

In general, our findings provide strong empirical support for the content validity of the immediacy concept. According to the expert ratings, the immediacy of specific regulation strategies not only differed from regulation problem to regulation problem, which, in line with theoretical approaches (e.g., Hadwin et al., 2018) and prior research (e.g., Malmberg et al., 2015), supports the view that regulation strategies should be used in situation-specific ways. It also shows that experts are able to concordantly identify an immediate regulation strategy for the majority of regulation problems we confronted them with (RQ1 and RQ2). Additionally, for each regulation problem, the expert ratings enabled us to clearly differentiate between various immediate and non-immediate regulation strategies for specific regulation problems because almost no regulation strategies turned out to be *somewhat* immediately effective for a given regulation problem (RQ3). These findings match our expectation that the immediacy concept represents a rather binary construct, that is, regulative control actions either directly address the core of the problem (= immediate strategy), or they do not (=non-immediate strategy). In summary, then, our findings reinforce the notion that the immediacy of strategy use concept bears a high content validity.

Therefore, the immediacy approach is a promising addition to prior regulation theories and frameworks such as Boekaerts (1999), Hadwin et al. (2018), Järvenoja et al. (2015) and Winne and Hadwin (1998) who emphasized that successful regulation involves situation-specific adaptations. All these theories and frameworks have been and still are extremely influential in research on self- and socially regulated learning and have coined the field's understanding of the conditions, processes, and effects of a successful regulation of collaborative learning processes. However, they remained remarkably unspecific about what exact regulation strategies learners should use in what specific situations. Now, the immediacy concept can provide a clear answer to this question: For any regulation problem that may appear during collaboration (at least the ones we covered in our study), students and educators can consult the graphs in Fig. 3 through 11 as well as Table 4 to be informed about *which* regulation strategies to use *exactly* in that very situation. For problem situations we did not cover in our study, students and educators can apply the immediacy concept themselves to determine the best strategy on a theoretical basis.

There are, of course, also boundary conditions for the usefulness and power of the immediacy concept. For example, the immediacy concept builds on the idea that certain regulation strategies and regulation problems can easily be isolated from each other. Yet, in reality, the regulation process is embedded in a complex social and individual context (e.g., Järvenoja et al., 2015; Hadwin et al., 2018; Winne & Hadwin, 1998). Therefore, the immediacy of strategy use concept might be criticized for overly simplifying what is happening during the regulation of problems. As especially qualitative studies that use in-depth process analyses of single groups' regulation processes show (e.g., Channa et al., 2024), in reality, multiple regulation problems or regulation strategies may be closely intertwined and mutually influence each other so that multiple problems can appear at the same time or cause each other, which might make a concerted use of multiple regulation strategies necessary (e.g., Azevedo, 2005; Azevedo & Witherspoon, 2009). Against this background, while we chose a quantitative approach in our study, we strongly recommend to probe the usefulness of the immediacy concept in qualitative, more process-related research on collaborative learning as well.

Also, it should be noted that the experts in our study did not always agree on the question which regulation problem should be regulated with which strategy. Therefore, our results might also be an indication of incompatible or at least competing theoretical assumptions and/or empirical findings for these problem-strategy-combinations. For instance, experts had different opinions whether the regulation strategy "Planning and Regulation of the Learning Process" (PLR) could be

considered immediate or not for a "Poor Relationship Quality". This might indicate that the research field has not yet arrived at an accepted view regarding what constitutes a high-quality learning process in collaborative learning. Based on regulation models like the three-layer model of self-regulated learning by Boekaerts (1999), some experts might perceive metacognition only as the organization of cognitive strategies to acquire knowledge. In other research areas, in contrast, regulation of social interactions and emotions within the group (Efklides, 2006; Marks et al., 2001; Vuorenmaa et al., 2023) and the engagement in positive emotional interaction (see Bakhtiar et al., 2018) are also part of a successful metacognitive process. Thus, our findings point to the need for the field to more clearly articulate its assumptions for the mechanisms of successful regulation, at least in specific sub-areas (namely especially in those where we found comparably low agreements between experts).

Overall, thus, the results of our study are valuable in two ways: First, in addition to already existing evidence regarding the criterion validity of the immediacy concept (Melzner et al., 2020), they also clearly support the content validity of the immediacy construct. And second, many of the single results of our expert study open up avenues for future research.

6. Conclusions

Despite its promising results, our study could also be critically discussed with respect to our methodological approach. For instance, some regulation strategy categories we presented to our participants can be criticized as including a rather broad range of different learning regulation strategies. According to Winne and Hadwin (1998), for instance, "setting goals for the learning process" can be differentiated from the "selection of learning strategies". However, we subsumed both regulation strategies as "Planning and Regulation of the Learning Process (PRL)". This decision to differentiate between only two metacognitive strategies was made based on data from real collaborative learning groups (e.g., Melzner et al., 2020) that indicate that certain regulation activities such as planning the learning process and selecting strategies are often intertwined with each other when groups try to regulate a specific problem. Still, it might be criticized for being too coarse-grained, though. Another limitation refers to how we determined our experts. We tried to find a valid balance between ensuring participants' expertise levels and arriving at a large enough sample size to yield a differentiated picture of possible assessments. Nonetheless, since the criteria on the basis of which we can determine "expertise" varies in related research (e.g., Eckerlein et al., 2022; Kaendler et al., 2016; Waldeyer et al., 2019), every selection process has to be critically discussed, including ours.

Without downplaying these limitations, our study adds substantial evidence that underscores the content validity of the immediacy of strategy use concept in collaborative learning. That said, we believe that the concept might spark many interesting research questions and practical implications. For example, subsequent research might investigate or train important precursors of groups' use of immediate strategies. These might lie on three levels: (a) the level of the individual learner, (b) the level of the group, and (c) the level of the instructional context in which the group collaborates. At the *individual level*, it might, for example, be interesting to investigate how learners' individual preconditions such as their conditional strategy knowledge (i.e., knowledge on what strategies to use in what situation; see Steuer et al., 2019; Paris et al., 1983; Wirth et al., 2025) or motivation to use regulation strategies (e.g., Dinsmore & Fryer, 2019) influences the adoption of immediate strategies. At the *group level*, research might investigate whether groups in which members share their perceptions of the current regulation problems they have (homogeneous problem perceptions) are more effective in their regulation processes than groups with heterogeneous problem perceptions (see Melzner et al., 2020). At the *instructional context level*, finally, future research could investigate whether groups' use of immediate regulation strategies can be effectively scaffolded, for example through group awareness tools (e.g., Schnaubert & Bodemer, 2022) or collaboration scripts (Kollar et al., 2007). For instance, the immediacy concept could help develop already existing tools such as the ones described by Borge (2022) or Strauß and Rummel (2021) to scaffold learners in initiating certain strategies based on the kind of problems they are facing. If, for instance, single group members dictate the workflow (="Lacking Procedural Fairness"), students could be presented bar charts depicting the number of the single students' contributions and/or be explicitly prompted to manage their workload and engagement. In addition, besides using the problem-strategy-pairs as basis for the aforementioned implicit or explicit just-in-time interventions, future research could examine how to teach the immediacy concept directly to the students. That is, instructors can educate their students on how to decide which regulation strategy to select in which problem situation. This approach to training might be easier to implement for teachers than intervening in specific situations that demand regulation (e.g., Magnusson et al., 2023). As can be seen from these considerations, the immediacy of strategy use concept, besides being valid both at a criterion and a content level, has a strong potential to inspire further research.

CRediT authorship contribution statement

Laura Spang: Writing – review & editing, Writing – original draft, Visualization, Resources, Methodology, Formal analysis, Data curation, Conceptualization. **Martin Greisel:** Writing – review & editing, Visualization, Resources, Methodology, Funding acquisition, Data curation, Conceptualization. **Ingo Kollar:** Writing – review & editing, Visualization, Supervision, Project administration, Methodology, Funding acquisition, Conceptualization.

Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this work, the author(s) used DeepL SE in order to improve language and readability. After using this tool/service, the author(s) reviewed and edited the content as needed and take full responsibility for the content of the publication.

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Declaration of interests

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Data availability

Data will be made available on request.

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