Engaging in writing to learn – Increasing the motivation during a long-term self-regulated learning training

Nina Udvardi-Lakos ⓘ*, Tino Endres ⓘ, Inga Glogger-Frey ⓘ†
and Alexander Renkl ⓘ

Department of Educational and Developmental Psychology, Institute for Psychology, Albert-
Ludwigs-University of Freiburg, Freiburg, Germany

Introduction: University students should be able to self-regulate their learning to gain the most from their studies. Extended self-regulated-learning trainings can help students to reach that goal. A frequent problem of such trainings is that students' motivation decreases over the course of training. To avoid this decrease, we combined a learning-journal-based, self-regulated-learning training with a learning environment teaching conditional knowledge about learning strategies, a guided peer-feedback system, and an optional intervention for students reporting low levels of motivation from the start of the semester.

Methods and Results: Four motivational variables were repeatedly measured over the course of 10 weeks. Students ($N = 103$) in our training showed an increase in their self-efficacy and intrinsic value, and a decrease in cost associated with learning-journal-writing throughout the semester. The optional intervention led to an increase in the intrinsic value associated with the learning journals for students with low motivation.

Discussion: Our study suggests that this expanded self-regulated-learning training can help students maintain their motivation during a long-term training.

KEYWORDS

motivation, self-regulated learning, learning-journal writing, expectancy-value theory, conditional knowledge

1. Introduction

At university, students should set learning goals, manage their time, use effective learning strategies, and monitor and revise their learning progress, if problems arise. These are all components of self-regulated learning (SRL) skills (Zimmermann, 2000; De Bruin et al., 2020). Students without these necessary skills face the risks of failing classes and dropping out of university (Wernersbach et al., 2014). Many students struggle with SRL demands when starting university, due to a sudden drop in the support available, after their

learning activities have largely been structured by teachers during their school years (Dresel et al., 2015). Therefore, it is sensible that universities provide support for students to learn effective SRL skills to avoid high attrition rates (Endres et al., 2021).

Many universities offer study skills courses or other classes to help students develop useful skills (e.g., Paris et al., 1983; Wernersbach et al., 2014). For example, one approach is creating awareness about and stimulating practice of effective learning strategies (Biwer et al., 2020a,b). Next to this direct support, where learners are instructed to use certain strategies, some interventions have used an indirect approach by giving learners opportunities to make use of their SRL strategies (Endres, in press). For example, one approach is using learning journals in teaching to enable students to monitor and regulate their learning (McCrindle and Christensen, 1995; Hübner et al., 2010). Learning-journal-writing can support the practice of SRL components (Hübner et al., 2010), especially when students are prompted to apply cognitive and metacognitive learning strategies while journal-writing (Nückles et al., 2009). For example, the Freiburg Self-Regulated-Journal-Writing Approach was developed, which supports students in applying learning strategies while writing by providing a set of prompts that was optimized over a series of studies (Nückles et al., 2020). By writing such learning journals, students can improve their learning activities and their learning outcomes, by organizing new contents, linking these contents to their prior knowledge (i.e., elaboration), monitoring their understanding, and repairing identified gaps in understanding (Weinstein and Mayer, 1986; Nückles et al., 2020). As learning-journal-writing often includes the awareness and practice of effective learning strategies, the latter approach can be seen as a very promising method of fostering SRL.

Unfortunately, learning-journal-writing is often experienced as a time-consuming and cognitively demanding activity (Nückles et al., 2020). Low motivation could lead to students not investing enough resources to successfully acquire SRL skills, and to high attrition rates (Eccles and Wigfield, 2002; Kosovich et al., 2017). For example, in studies on the Freiburg Self-Regulated-Journal-Writing Approach, learners' motivation to engage in journal writing decreased over the course of the semester (Nückles et al., 2010, 2020). In one experiment, learners wrote regular learning-journal entries over an entire semester, while receiving prompts to apply cognitive and metacognitive strategies (Nückles et al., 2010). There was an increased use of such strategies and higher learning outcomes compared to a control group that received no prompts. However, the use of strategies in the experimental group decreased towards the end of the semester, as did learners' motivation for writing journal entries. Motivation was assessed using three components: learners' enjoyment of, invested effort in, and perceived competence for learning-journal-writing; all three showed a decrease.

This decrease might have been due to an expertise-reversal effect, that is, too much support for learners having gained some expertise in journal writing. In a second experiment, the prompts were gradually reduced over the course of the semester (Nückles

et al., 2010). This fading led to an increase in the use of cognitive strategies compared to a control group that received permanent prompts. Unfortunately, learners in both groups showed a decreasing enjoyment, while the invested effort and perceived competence did not change significantly over time in either group. This pattern matches previous studies where students' motivation typically decreases during a semester (Nicholls et al., 2015; Kosovich et al., 2017). Low motivation has also been found in other long-term SRL trainings (Biwer et al., 2020a).

Some studies suggest that the detrimental effect of journal writing on students' motivation could be counteracted by beneficial effects regarding learners' motivation to engage with the content knowledge of the journal entries (Wäschle et al., 2015; Nückles et al., 2020). For example, the use of prompts that ask students to reflect on the personal relevance of the learning materials helped maintain students' motivation (Schmidt et al., 2012). However, these methods of avoiding a motivational decrease may depend on the learning content, and how well learners can reflect on its personal relevance.

Therefore, our goal is to improve the (use of the) Freiburg Self-Regulated-Journal-Writing Approach so that learners' motivation is sustained throughout the training. We combined this method with a learning environment teaching conditional knowledge about learning strategies and a guided peer-feedback system that enables students to gain a more accurate impression of their own skills. Both additional components were expected to foster students' self-efficacy for and value associated with learning-journal-writing. We also provided an optional motivational intervention for students showing low levels of motivation at the start of the semester, to avoid low levels of engagement and learning outcomes of these at-risk students.

Our approach is based on the Expectancy-Value Theory of motivation, which offers options to sustain motivation (Atkinson, 1957; Wigfield and Eccles, 2000). According to this theory, people are motivated (a) when they believe they can accomplish the task (expectancy), and (b) when they believe the task is meaningful (value), and the benefit or value of the task exceeds the costs (e.g., effort) involved (Wigfield and Eccles, 2000; Barron and Hulleman, 2015). In the following sections, we will describe the theoretical basis of our approach, and match the components of motivation to the additional components of the journal-writing approach. We will explain how the expectancy and the value could be increased by providing conditional knowledge and peer-feedback. Then, we will describe the learning environment teaching conditional knowledge about learning strategies and a guided peer-feedback system and their implementation in our approach. Lastly, we will describe our optional motivational intervention for at-risk students.

First, we want to explain how motivational components could be addressed during our SRL training. For the expectancy part of motivation, a crucial facet is self-efficacy, such as students' confidence in being able to use a certain learning strategy (Bandura, 1977; Hulleman et al., 2016). The

value component incorporates four facets: (a) intrinsic value relates to the inherent enjoyment associated with a task (e.g., writing a learning journal), (b) utility value relates to the usefulness of the task for an individual's goals (e.g., learning effectively to get good grades), (c) attainment value stands for the importance of a task for an individual's self-concept (e.g., being an effective self-regulated learner), and (d) cost, which includes for example the effort associated with the task (e.g., effort needed for writing a learning journal; Wigfield and Eccles, 2000; Hulleman et al., 2016). We identified methods to address these components to sustain students' motivation during SRL trainings.

As indicator of their expectancy, students' self-efficacy for using learning strategies is expected to depend mostly on students' performance accomplishments (Bandura, 1977). If students experience that they can accomplish a certain level of performance (e.g., write a good learning journal entry), they will feel more motivated during the task (while writing the next journal entry). We have identified two issues that may prevent students from experiencing this feeling of accomplishment for learning-journal-writing.

On the one hand, students may lack knowledge about how, why and when to use effective learning strategies in learning journals (conditional knowledge). This lack of conditional knowledge may lead to low self-efficacy for implementing learning strategies in learning journals, as students feel more confident in using less effective, but well-known surface-level strategies, such as re-reading (Biwer et al., 2020b). Consequently, students will lack motivation for learning-journal-writing, where more complex strategies are demanded (Bandura, 1977; Eccles and Wigfield, 2002).

On the other hand, students usually write learning journals over several weeks and only receive feedback at the end of the semester, so they may perceive no performance accomplishment until then. As students do not know whether they have accomplished the goals of a good learning journal, the development of self-efficacy could be hindered by the lack of feedback. Consequently, students' motivation may decrease over the semester, as previously observed (Nückles et al., 2010, 2020).

Possibly, students' motivation could be improved by increasing their self-efficacy: by providing conditional knowledge about learning strategies, and by providing more frequent feedback earlier during the semester so students can experience performance accomplishment.

The same two issues could also be addressed to increase the value associated with learning-journal-writing. If students lack conditional knowledge about effective learning strategies, they may believe that these strategies are not useful. Hence, students may be unwilling to invest high effort into more demanding, but effective, strategies and return to using surface-level strategies (Endres, in press). Learners could perceive learning-journal writing and the cognitive load associated with implementing learning strategies as costly (Nückles et al., 2020). Learners might think that the time and effort invested in journal-writing has

negative effects on other academic and non-academic activities (Nückles et al., 2020). Therefore, explaining the value of effective learning strategies could foster favorable views of these strategies and support students' motivation for learning-journal-writing.
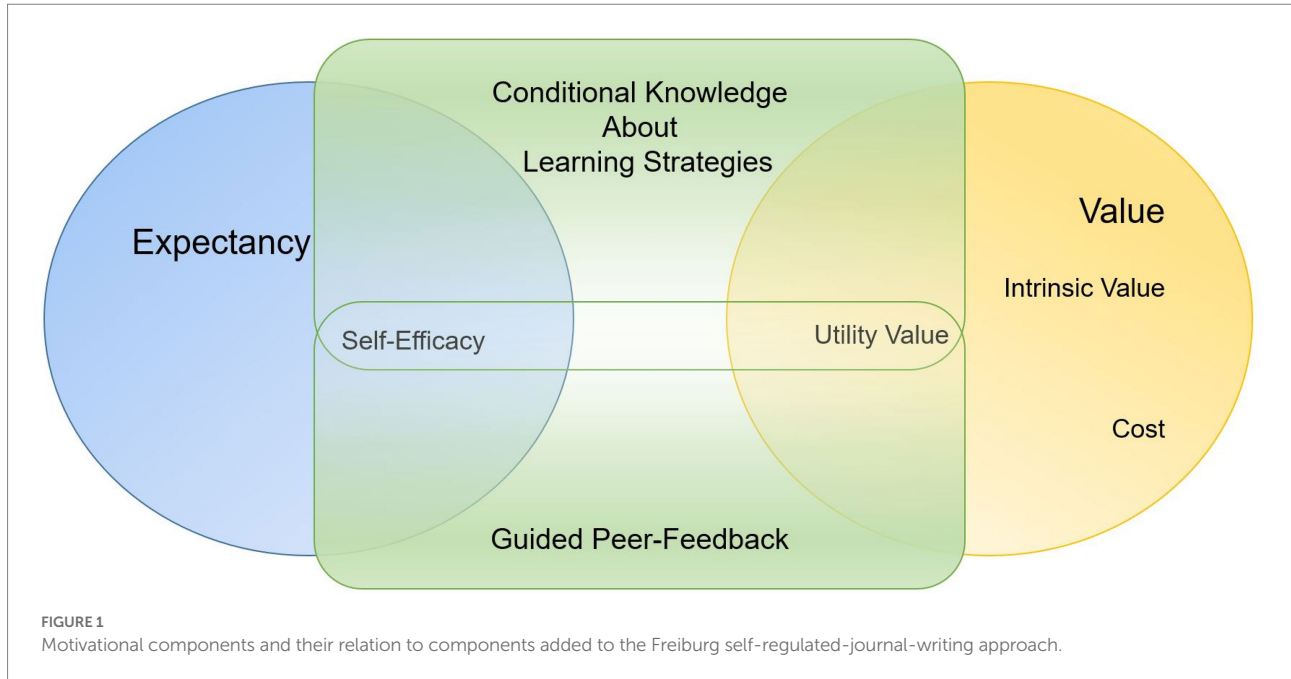
Receiving frequent feedback could also support students' utility value associated with learning journals, as they can more easily track their learning process. Through feedback, students could see which concepts they have understood and which aspects they should focus on more (Hattie and Timperley, 2007). If students receive positive feedback for their learning journals, they may value the learning journals more, as the effort invested into learning-journal-writing pays off.

As conditional knowledge about learning strategies and more frequent feedback could foster both expectancy and value components of motivation, we enriched the Freiburg Self-Regulated-Journal-Writing Approach with two additional components (see Figure 1). A computer-based learning environment teaching conditional knowledge, and a guided peer-feedback system. For these components, we used tried-and-tested materials and interventions, which have been shown to support student learning in previous studies (Bürgermeister et al., 2021; Endres et al., 2021).

Second, we will illustrate the two additional components and their implementation. Learning strategies-focused trainings can foster students' conditional knowledge about and use of effective learning strategies (Biwer et al., 2020a). For this purpose, Endres et al. (2021) developed and tested a computer-based learning environment, which introduces students to resource-oriented, cognitive, and metacognitive learning strategies (Weinstein and Mayer, 1986). In this learning environment, students are informed about why these strategies are useful, and how and when they can be applied (Endres et al., 2021). It also includes repeated and spaced retrieval practice opportunities, which support learning (Bjork, 1970; Rowland, 2014; Carpenter et al., 2022).

This learning environment has been shown to increase students' conditional knowledge about learning strategies, their learning intentions, and self-reported learning strategy use using several studies (Endres et al., 2021). Increasing students' conditional knowledge about learning strategies should increase their self-efficacy for using these strategies, which should help maintain their motivation for learning-journal-writing. As the learning environment also explains why the strategies are useful, it could foster students' utility value associated with the learning strategies used in the SRL training.

Frequent feedback could support students' self-efficacy for and perceived utility of learning-journal-writing. Due to the high number of students taking part in many first year University courses, providing individual feedback for regular assignments, such as learning journals, often exceeds teachers' capacity. Instead, for reasons of feasibility, one option is to use a peer-feedback system, where students give feedback to each other. Peer-feedback can promote students' writing performance and learning of domain-specific skills (Huisman et al., 2018, 2019). Peer-feedback also has the advantage that students can see that the learning

FIGURE 1
Motivational components and their relation to components added to the Freiburg self-regulated-journal-writing approach.

strategies are used by others who are like them, and how their peer implemented these strategies (Schunk and Hanson, 1985; Endres, in press).

Unfortunately, students often struggle with providing useful, high-quality feedback. However, students' skill of formulating peer-feedback can be improved (Van Zundert et al., 2010), for example, by providing a guided peer-feedback system. In previous studies, this type of system helped students compose peer-feedback on learning journals by (a) providing rubrics to assess the use of learning strategies, and (b) supporting the formulation of feedback using sentence starters, leading to a higher quality of peer-feedback (Bürgermeister et al., 2021). We used this guided peer-feedback system to boost students' motivation, by increasing their self-efficacy associated with learning-journal-writing. The peer-feedback should also increase the utility value associated with the learning journals, as students can track their learning process and see how their invested effort pays off.

Lastly, we will describe our additional intervention for at-risk students, who require additional support to increase their motivation. Students who already show low motivation at the beginning of the semester, when they are just learning about learning-journal-writing, may be at risk of investing low effort and even dropping out if their motivation decreases even further. If they experience low motivation, "at-risk" students may not be willing to invest effort into formulating and implementing feedback (Hattie and Timperley, 2007). Thus, our planned approach may not be enough to motivate these students. To avoid leaving such students behind, we want to identify these "at-risk" students, who report low levels of motivation at the beginning of the semester, and to offer them a short optional intervention. This intervention re-iterates important components of the learning strategies and their implementation in learning journals, halfway through the semester.

The motivational intervention used informed training (Brown and Palincsar, 1982; Paris and Jacobs, 1984) to address student concerns and difficulties associated with the learning journals. Informed training refers to the idea that learners need to understand consequences, advantages and disadvantages, and conditions under which to use different approaches (Friedrich and Mandl, 1997), and could support students' value associated with learning-journal-writing. The motivational intervention also included complementary strategies students could use to set realistic goals, focus on specific aspects, and monitor their work. These strategies were expected to support students' motivation by reiterating principles of SRL (planning, implementing, evaluating; Muis, 2007; De Bruin et al., 2020) and thus making it easier for students to regulate their learning efforts, increasing their self-efficacy and value for and decreasing the cost of learning-journal-writing.

As students may experience different issues affecting their motivation for learning-journal-writing (e.g., Biwer et al., 2020b; Nückles et al., 2020), we prepared an adaptive intervention where students could choose their main difficulty: self-efficacy, value, or cost associated with learning-journal-writing. Based on this choice, different aspects of learning strategies were explained and different complementary strategies were proposed. This adaptivity was thought to allow us to address the various concerns at-risk students may have.

To sum up, long-term SRL trainings can foster students' SRL skills and their learning outcomes. However, learners' motivation often decreases during these trainings. We implemented a combination of support systems to help sustain students' motivation. To assess the effect of this combination, we examined how students' motivation changes over the course of one semester, while writing learning journals as SRL training element. We addressed the following research questions:

1) Can the addition of a computer-based learning environment targeting conditional knowledge as well as a guided peer-feedback system avoid the usually observed decrease in motivation?

2) Can an optional motivational intervention help to increase at-risk students' motivation associated with learning-journal-writing?

2. Materials and methods

2.1. Sample and design

Our sample consisted of 116 undergraduate psychology students in a first-year developmental psychology module at the University of Freiburg. They were informed of the research project, and 103 students gave consent for their data to be used for research purposes. We used a quasi-experimental between-subjects design with 10 repeated measures. Students answered four items relating to the expectancy and value components of motivation: self-efficacy, utility value, intrinsic value, and effort cost associated with learning-journal-writing. These variables were chosen based on the expected effects of our enriched approach and the optional intervention for at-risk students. Students rated these items after each learning journal entry written throughout the semester, representing 10 time-points of measurement. Students who rated their first five journal entries on average below the midpoint of the scale (3.5 out of 1 to 6) were categorized as at-risk ($n = 46$), and invited to complete the motivational intervention on a voluntary basis halfway through the semester. Of these, 20 students completed the intervention.

2.2. Materials and instruments

2.2.1. Computer-based learning environment on conditional knowledge

All students completed the computer-based learning environment (Endres et al., 2021) at the start of the semester. They were taught cognitive, metacognitive, and resource-based learning strategies (Weinstein and Mayer, 1986). More specifically, the training focused on conditional knowledge about the advantages and disadvantages of strategies in various practice situations, and students got to know different application contexts for the learning strategies. An adaptive system using retrieval practice helped to consolidate this knowledge about learning strategies (Rowland, 2014). A demo version of this learning environment can be accessed (in German) using the following link.[1] A link to the new, English version, is also now available.[2]

---

[1] https://elis.vm.uni-freiburg.de/demo

[2] https://paedx.clp.vm.uni-freiburg.de/

2.2.2. Learning journals

Following the results of Nückles et al. (2009, 2020), students had to complete weekly learning journal entries after reading the week's literature and watching the online lecture on developmental psychology as part of the course requirements. In the learning journals, they had to use various learning strategies they had been introduced to in an introductory lecture on learning-journal-writing and in the computer-based learning environment. Students had to write at least 700 words for each journal entry and use at least one strategy effectively (e.g., by explaining a new theory using a personal example, or organizing new concepts in a mind-map). Students had to complete at least eight of the 10 possible learning journal entries to pass the module. Students who handed in fewer learning journal entries or did not write at least 700 words risked having to re-take the entire module. Most students completed eight learning journal entries (51.5%), with 26.2% of students completing nine and 16.5% completing 10 entries. Only 5.8% of students completed less than the eight required entries (for a breakdown of journal entries, see Table 1). When grouping the students who had completed at least eight learning journal entries according to the number of entries written, no significant difference was found between the three groups for any of the motivational items (all ps > 0.050).

2.2.3. Peer-feedback

Every week, students received another student's learning journal entry and provided peer-feedback on the use of strategies. They used a digital tool that helped students assess the use of learning strategies using rubrics and supported the formulation of feedback using sentence starters. This type of support has been shown to foster students' feedback quality (Bürgermeister et al., 2021). Students had to complete eight peer-feedbacks to pass the module. All students fulfilled this requirement. Due to the use of the peer-feedback tool, the peer-feedback quality was expected to meet a minimum quality, such that the feedback fulfills important criteria for judging the use of learning strategies (by indicating the quality of the implementation using the rubrics, e.g., judging the use of an elaboration strategy based on the provision of a relevant example) and giving suggestions for further improvement (based on the sentence starters, e.g., by suggesting links to other theoretical concepts). Examples for such aspects, taken from typical peer-feedbacks, can be found in Table 2.

2.2.4. Assessing motivation for journal writing

We assessed components of the Expectancy-Value Theory (Wigfield and Eccles, 2000; Barron and Hulleman, 2015) using four self-rating items (see Table 3). To measure students' expectancy, we assessed their self-efficacy in applying learning strategies in the learning journals. To measure students' value associated with learning-journal-writing, we used items assessing utility value, intrinsic value, and the effort demanded. After each learning journal, students rated how much they agreed with each item, from *not at all* (1) to *very much* (6). Baseline levels of the four items were calculated using the first five learning journal entries, which showed acceptable internal consistencies over time. As the items were thought to measure different theoretical

TABLE 1 Overview of learning journal entries written.

Learning Journal	1	2	3	4	5	6	7	8	9	10
Number of students (%)	103 (100)	103 (100)	100 (97)	99 (96)	99 (96)	98 (95)	98 (95)	99 (96)	82 (80)	67 (65)

aspects of the motivational components, they were analyzed separately instead of combining them into scales.

2.2.5. Optional intervention for at-risk students

We offered the motivational intervention halfway through the semester, to give us time to identify at-risk students. During the intervention, participants were first asked to choose which aspect they saw as their main difficulty (self-efficacy, value, or cost associated with learning-journal-writing). Then, participants could give a more fine-grained answer to what they thought was difficult when writing learning journals by indicating which of several options apply to them (e.g., "I think my own learning strategies are more useful than the ones used in the learning journals"). Depending on their main difficulty, participants saw one of three sketched-explanation videos, using emotional design to increase situational interest and reduce cognitive demand (Endres et al., 2020). In each video, a character described their difficulties with learning-journal-writing (matched to the main difficulty the students reported) and asked a lecturer for help. The lecturer then explained the value of properly implementing learning strategies in the journals and proposed several complementary strategies students could use to support their writing. For example, if students indicated that they perceived the cost to be too high, the lecturer recommended using a study plan to allocate time to specific learning activities and regulating the time spent on learning-journal-writing. Using this informed training, the complementary strategies and the re-iteration of the SRL process should help students reflect on their own behavior and foster favorable beliefs about learning-journal-writing.

The videos were divided into three phases (see Figure 2). In the planning phase, the character reflected on their difficulties and talked to the lecturer. In the implementation phase, the character implemented their new knowledge when writing the next journal entry. For example, if students had been recommended to use a study plan, the character noted how long it had taken them to write the learning journal and whether this matched the allocated time in their study plan for the week. In the evaluation phase, the character reflected on their application of new strategies and decided on which strategies they would use in the future. After seeing the videos, participants were asked which strategies they thought were particularly relevant, which ones were easy to apply, and which ones they planned to use in the future. The videos took about 8 min and the intervention overall took approximately 15 min. The intervention videos are available at the link provided for data availability.

2.3. Procedure

Students completed the computer-based learning environment in the first week of the semester. They were introduced to different learning strategies in the introductory lecture to the developmental psychology module. The week after, all students had to write their first learning journal entry and were given general feedback on common sub-optimalities (on the strategy level) and misconceptions (on the content level) found in learning journals in the following module session. For the next five weeks, students completed the weekly learning journal entries. They gave and received peer-feedback. They rated their motivation for each learning journal entry using the four items after writing the respective entry. After five weeks, we invited students who we categorized as at-risk to complete the motivational intervention. They received a link and could access the motivational intervention for a week. All students wrote further learning journal entries. They gave and received peer-feedback, and they rated the motivational variables for each learning journal entry until the end of the semester.

2.4. Data analysis

We used multilevel models to analyze the development of each of the four motivational variables separately (Dataset: Udvardi-Lakos et al., 2021). We included up to four predictor variables in our models. The Session, or time-point when each learning journal was written, was used as predictor as the motivational variables were expected to show a linear trend over time. The learning journal entries were coded as Session 0–9. The intercept of a multilevel model starting at the first level with 0 as first session indicates differences in students' level of motivation at the beginning of the semester and the slopes indicate the trajectory of the motivational variables over the course of the semester. As the motivational variables were single items, we calculated their reliabilities for the intercepts and slopes in the multilevel models using the following formula:

$$\lambda_j = \frac{\tau_{00}^2}{\left(\tau_{00}^2 + \sigma^2 / n_j\right)}$$

We added Intervention Group as predictor to indicate which students had completed the intervention for at-risk students ($n = 20$) and which ones had not ($n = 83$). We invited students identified as at-risk to complete the motivational intervention halfway through the semester. As we categorized students who had rated their motivation low as at-risk, the motivational ratings of the at-risk students should be lower than for the other students. So, Intervention Group was expected to have a main effect on the motivational variables due to a selection effect.

TABLE 2 Sample excerpts of the peer-feedback.

Example 1 – for learning journal 2	
Organization	Starting from a question from the previous learning diary, you have organized the content. You have asked yourself to what extent interpersonal interactions promote the development of children according to Vygotsky. You answered this question with the concept of "internalization," which you use to guide the rest of the structure. You explain the concept first on a theoretical level, you can also mention the relationship between innate predispositions and their activated development as well as the "zone of proximal development." You deepened your understanding by using examples and with learning to write also your own experience. Your personal criticism is also coherent. Your choice and preparation of topics makes sense to me.
Metacognition	With internalization, you mention a term that was initially incomprehensible to you. It makes sense to explain it afterwards (and supports the organization). You would like to answer the question regarding individual development steps by conducting an online research. Our lecturers would say: Here you regulate your learning progress.
Example 2 – for learning journal 4	
Organization	You have used a very good organization structure in this learning journal entry. You succeeded especially with the comparison to Piaget, which runs as a red thread through your LJ. With the introductory clarification of still existing difficulties in understanding (encoding) you introduce the topic well. You have addressed the most important central contents with the description of the core knowledge thesis and the change in theory. The didactic implications (as far as I know, our Professor mentioned them in the learning objectives for this topic) might also be relevant.
Elaboration–previous knowledge and own experience	On the whole, you succeeded very well in your elaboration. You linked many phenomena with your own experiences along the development of concepts and connections to the topic of theory. I liked the fact that these were experiences that you not only learned from other children, but that also affected you personally, such as playing memory games. In my opinion, it strengthens the bond to the learning material and thus the understanding if you can relate it to yourself.
Elaboration–Usefulness	With the elaboration strategy, the personal relevance of the material should be expressed. On the one hand, you establish a reference to yourself, but it is more about experiences from the past. I particularly liked the insight into how you should deal with the learning material according to the information processing approach. This shows that you have understood the content and can use it for self-optimization. However, this refers to the usefulness of the material from last lesson. Optionally, you could directly mention in your respective LTBs how what you learned can help you currently and in the future.
Example 3 – for learning journal 7	
Organization	As always, you did a great job with the organization. You have structured your learning diary entry clearly and clearly structured and summarized key points and their interrelationships.
Elaboration–previous knowledge and own experiences	Right at the beginning you explained which questions you have already asked yourself in the past about moral behavior. Your two examples illustrated the content well and had a personal a personal reference.
Elaboration–Usefulness	You cited what practical relevance the content could have.
Metacognition	You explained how the topic could be useful to you and how you structured your learning diary entry to maximize your learning.
Comments on content, answers to open questions, divergent Viewpoints	Your summary of the stage model will be helpful for your exam preparation, or if you want to look up something again at a later point in time. I especially liked your example with the earthquake in Croatia. Here you have linked many aspects of the theory and illustrated them well. I do not know the restrictions because of the Corona pandemic in Croatia, but if there are similar restrictions as in Germany–could one not even say that the people acted on the 6th level acted according to Kohlberg? They would then have acted in the best interests of the affected people, they would have disregarded the applicable contact restrictions. What do you think?
Example 4 – for learning journal 10	
Elaboration–Usefulness	You have shown the application of this topic and the relevance for every one of us really well, even though you may not have explicitly titled it that way.
Comments on content, answers to open questions, divergent Viewpoints	Actually, my feedback is almost superfluous, because you can see how much you have immersed yourself in the subject and how well you were able to link it with your own experiences and examples. Thank you for your super written and very personal LJ. I especially liked the part where you reflected on what it would actually take for the children. Overall, your entry has inspired me and touched me very much, and I wish everyone would understand it / think like you.

TABLE 3 Self-rating items answered after every learning journal.

Item	Motivational component	Internal consistency over time (Cronbach's alpha)
I am confident that I am able to apply good learning strategies when writing learning journal entries.	Self-efficacy	0.884
Writing this learning journal entry was helpful.	Utility value	0.803
I was motivated to write this learning journal entry.	Intrinsic value	0.653
Writing this learning journal entry required effort.	Effort cost	0.756

Phase 1: Planning – Reporting difficulties associated with learning-journal-writing

Phase 2: Implementation – Implementing new strategies explained by the lecturer

Phase 3: Evaluation – Comparing own progress with learning goals and adapting process if necessary

FIGURE 2
Screenshots from one of the sketched explanation videos explaining different strategies for writing learning journals.
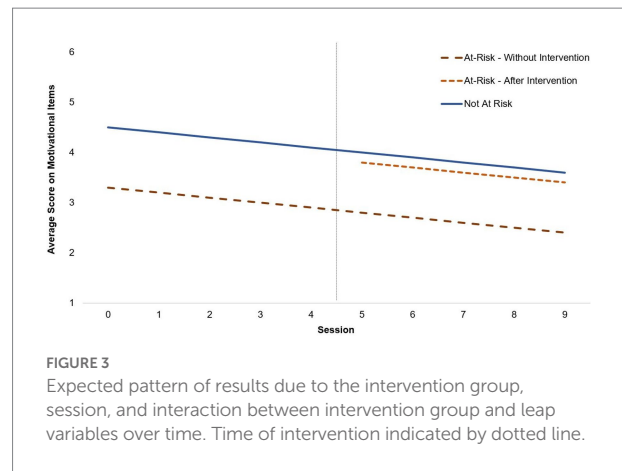
We included a Leap variable that subsumed sessions (0–4) before the intervention, and sessions after the intervention (5–9) to be able to judge whether the onset of the at-risk intervention influenced the expected linear progress learners made over the course of the semester, where a difference between these two time blocks for the intervention group would indicate an intervention effect. The interaction between participating in the motivational intervention (Intervention Group) and the Leap variable was added as predictor. Such an interaction would indicate whether completing the motivational intervention had an effect on motivational ratings taken after the intervention.

We expected a significant difference between the time before and after the intervention for students who had completed the intervention, but no significant difference for students who did not complete the intervention (see Figure 3). An interaction between Intervention Group and the Leap variable should show whether completing the interaction halfway through the semester influenced the linear trend assumed for the motivational variables.

The multilevel models each had two levels (see Table 4). The first level corresponds to the subjective ratings on the four motivational variables. On this level, we included Session and Leap. The second level corresponds to the individual students. On this level, we included Intervention Group and the interaction Intervention Group*Leap as predictors of students' motivational ratings.

We tested three models for each motivational variable, comparing the fit between these to find the best model to explain the data. The first, simple model only included Session as random factor and student as Level 2 variable. This model was chosen to include the expected linear development of motivation over time

FIGURE 3
Expected pattern of results due to the intervention group, session, and interaction between intervention group and leap variables over time. Time of intervention indicated by dotted line.

and any individual differences. The second model included Session, Leap, and student. This model was tested to see whether the onset of the intervention halfway through the semester could explain any individual differences found in the first model. Leap was added as control variable, as we did not expect this variable alone to add to the explained variance, without the interaction effect with the Intervention Group. However, we wanted to control for any other influences on student motivation, such as the winter break, which occurred between Session 4 and 5, or influences of the topic knowledge covered in the learning journal entries.

The third, complex model included Session, Leap, Intervention Group, the interaction between Intervention Group and Leap, and the student level. This model therefore included all variables

TABLE 4 Variables added as predictors for each of the two levels of the multilevel models.

Level 1	Description	Coded as
Session	Subjective ratings for each of the 10 learning journal entries	0, 1, … 9
Leap	To control for the effect of the time of the intervention, which took place between Session 4 and 5	"0" for Session 0–4 "1" for Session 5–9
Level 2		
Intervention Group	Indicates whether or not students completed the motivational intervention	"0" (No) "1" (Yes)
Intervention Group*Leap	Differences in the subjective ratings of the motivational components due to participating in the motivational intervention	

measured, to see whether the intervention had an effect over and above any main effects of Intervention Group and Leap. We included Session and Leap as random effects, Intervention Group and the interaction as fixed effects.

Although there is no standard procedure used as power calculation for multilevel models, a power calculation assuming an ANOVA with multiple measures can approximate the sample size needed (Schoppek, 2015). In a meta-analysis of studies on SRL trainings (Dignath and Büttner, 2018), an average effect size of $d = 0.69$ was found for primary and secondary school students, for both cognitive and motivational outcomes. Similarly, in previous studies on SRL trainings for university students, medium effect sizes have been found (Biwer et al., 2020b; Endres et al., 2021). Based on this research, we assumed a medium effect size for our intervention. A power calculation using G*Power 3.1.9.7 indicated that for a mixed factorial ANOVA with two measurements (before and after the intervention), assuming a medium effect size of $d = 0.50$, $\alpha = 0.05$ and a power of 0.80, a sample size of 34 would be needed. Although our at-risk participant group was quite small ($n = 20$), sufficient power should be achieved for some tentative interpretations of our results.

2.5. Ethics statement

We conducted this study in accordance with the German Psychological Society's DGPs (2016) ethical guidelines. According to the German Psychological Society's ethics commission, approval from an institutional research board only needs to be obtained if funding is subject to ethical approval by an Institutional Review Board. The participants provided informed consent allowing us to use their data. All data was pseudonymized after collection and later anonymized.

3. Results

Our overall goal was to see whether we could prevent the decrease of motivation over the course of the semester and keep students motivated when writing learning journals. The first research question was whether the addition of a

computer-based learning environment targeting conditional knowledge as well as a guided peer-feedback system could help avoid the usually observed decrease in motivation associated with learning-journal-writing. To answer this question, we tracked the values of four motivational variables across all students over the semester (see Figure 4). On a descriptive level, it looks like the motivational variables did not show a consistent decrease over time.

We conducted multilevel models to analyze the linear trend of the four motivational items and the influences of the Group and Time effects and their interaction. Only the results pertinent for our research questions will be discussed here (detailed results can be found in the Supplementary Material).

In the simple models, Session had a significant, positive effect on the self-efficacy for implementing learning strategies ($\beta = 0.13$, $p < 0.001$), indicating a linear increase in students' self-efficacy. Session had a significant positive effect on students' intrinsic value associated with the learning journals ($\beta = 0.04$, $p = 0.005$), suggesting an increase in the enjoyment of learning-journal-writing. Session also had a significant negative effect on the effort cost demanded by the learning journals ($\beta = -0.09$, $p < 0.001$), indicating a linear decrease in the effort cost students reported, suggesting that learning-journal-writing became easier over time.

Hence, students showed a positive development over time for the self-efficacy and intrinsic value, but a negative development over time for the effort demanded. As the predictor Session was not significant for the utility value, students' perceived usefulness of the learning journals did not change significantly throughout the semester. This finding suggests that the students experienced a combination of increasing self-efficacy for implementing learning strategies and intrinsic value, constant levels of utility value, and decreasing effort demanded, which led to a positive change in the motivation over time.

Our second research question was whether the motivational intervention for at-risk students could help to increase the motivational variables. An intervention effect would be indicated by a significant interaction between Intervention Group and Leap, showing that students who completed the intervention showed a change in their motivational ratings from before to after the intervention. Intervention Group was also expected to reach
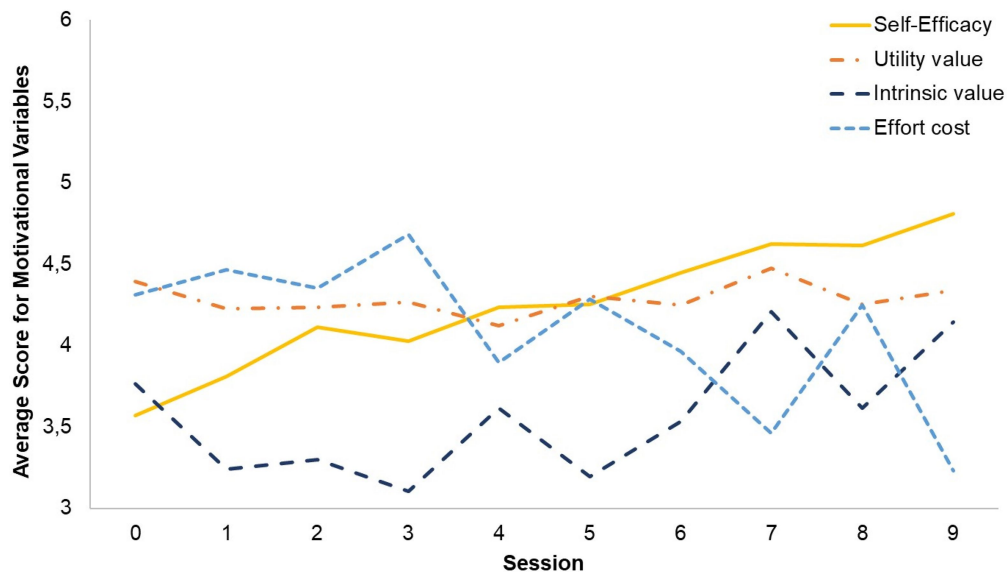
FIGURE 4
Average values for the four motivational variables measured for the 10 learning journals throughout the semester. *X*-axis starts at 3; *N*=103.

significance due to a selection effect based on the method of categorizing students as at-risk.

Multilevel analyses showed that the intervention effect was significant for the intrinsic value, shown by a significant interaction of Intervention Group*Leap ($\beta = 0.52$, $p = 0.006$). We also found a significant effect of the Intervention Group ($\beta = -0.75$, $p < 0.001$) and Leap ($\beta = 0.47$, $p = 0.003$). In the first model, there was significant variance in intercepts across students (Var (u0j) = 0.38, $p < 0.001$, $\lambda = 0.999$), but no significant variance in the slopes (Var (u_{1j}) = 0.002, n.s., $\lambda = 0.980$). In the third model, the individual differences in intercepts were non-significant (Var (u_{0j}) = 0.20, n.s., $\lambda = 0.997$), suggesting that the additional variables in this model were partly able to explain the individual differences found previously.

For the utility value, the interaction Intervention Group*Leap did not reach significance. As expected, belonging to the intervention group was significant ($\beta = -0.70$, $p = 0.001$). In the simple model of utility value, there was significant variance in intercepts (Var (u_{0j}) = 0.72, $p < 0.001$, $\lambda = 0.999$) and slopes (Var (u_{1j}) = 0.01, $p = 0.021$, $\lambda = 0.998$) across students. In the third model, this significant variance in intercepts (Var (u_{0j}) = 0.61, $p < 0.001$, $\lambda = 0.999$) and slopes (Var (u_{1j}) = 0.02, $p = 0.023$, $\lambda = 0.998$) across students remained. Including the Intervention group, Leap, and their interaction was only partly able to explain individual differences for the utility value. Thus, the motivational intervention was only successful for the intrinsic value.

A MANOVA found no significant differences between at-risk students who had been invited but did not participate in and those who completed the intervention on any of the four motivational items aggregated across the first five sessions (all $ps > 0.050$).

Before the onset of the intervention, at-risk students who chose not to complete the intervention did not differ in their motivation from students who completed the intervention.

In summary, students' motivation for learning-journal-writing did not decrease over time; for the case of students' self-efficacy, intrinsic value and effort cost we even found favorable developments. Our motivational intervention significantly increased at-risk students' intrinsic value associated with the learning journals.

4. Discussion

We implemented two components to increase students' motivation during an SRL training: conditional knowledge about learning strategies and peer-feedback. Furthermore, we offered an optional motivational intervention to at-risk students. We expected that this enriched learning-journal-writing approach would sustain all students' motivation throughout the semester by increasing expectancy and value components associated with SRL training (Wigfield and Eccles, 2000; Barron and Hulleman, 2015).

Our results suggest that students' motivation did not generally decrease during the training, as identified as general problem in previous studies (e.g., Nückles et al., 2010; Biwer et al., 2020b). Against usual trends, our additional components actually increased motivation towards the end of the semester. This finding suggests that the approach combining a SRL training element (learning-journal-writing) with conditional knowledge (computer-based learning environment) and feedback (guided peer-feedback system) can support students' motivation during a long-term training. The computer-based learning environment

and guided peer-feedback were expected to increase self-efficacy for learning-journal-writing and the utility value associated with learning journals. Our findings largely matched these expectations.

Furthermore, our optional intervention for at-risk students was successful in increasing only one motivational variable, the intrinsic value associated with learning journals. These results only partially confirmed our expectations that the intervention would foster motivation in at-risk students. However, as there was no significant negative interaction, we were at least able to sustain at-risk students' motivation throughout the semester as well as that of not-at-risk students.

4.1. Changes in motivation over time

Corresponding to the expectancy component of motivation, students reported an increase in their self-efficacy for implementing learning strategies in learning journals. As expected, the conditional knowledge about learning strategies and the peer-feedback seem to have increased students' self-efficacy for learning-journal-writing.

The utility value remained relatively constant over the entire semester. Students may have formed an initial appraisal of the utility of the learning journals and did not amend this appraisal throughout the semester. We expected that conditional knowledge about learning strategies would increase the utility value associated with learning-journal-writing. However, as students completed the computer-based learning environment before the first learning journal, we could not directly assess the effect of the conditional knowledge on the utility value. It is possible that without the conditional knowledge, the utility value would have decreased over time.

However, we also found that the intrinsic value associated with learning-journal-writing improved, contrasting with previous studies that reported a decrease in the intrinsic value (Nückles et al., 2010). Together with the decrease in effort cost found here, our results show a promising pattern: Overall, students' motivation increased over the course of the semester, due to an increase in the self-efficacy and a decrease in the cost associated with the SRL training. The program combining the learning-journal-writing approach with the computer-based learning environment and the guided peer-feedback system was actually perceived as motivating, compared to other long-term trainings.

4.2. Effect of the motivational intervention for at-risk students

We also examined the effect of a motivational intervention offered to students reporting low levels of motivation at baseline, who were at higher risk of investing few resources into learning-journal-writing, of low learning outcomes, and attrition. We wanted to see whether this intervention could help at-risk students increase their motivation in the second half of the

semester. Although our motivational intervention was aimed at increasing motivation overall, only one motivational variable, the intrinsic value, was predicted by the completion of the intervention.

This result indicates that at-risk students experienced more inherent enjoyment when writing learning journals after the intervention. As no other motivational variable was affected by the motivational intervention, an explanation for the sole influence on the intrinsic value is needed. The motivational intervention reiterated conditional knowledge of when to use learning strategies, why these strategies are useful, and introduced complementary strategies that could help implement learning strategies. Perhaps this additional information enabled students to see the value associated with the learning journals, helped them overcome initial appraisals of learning-journal-writing as difficult and effortful activity and allowed them to enjoy the task.

Using an adaptive intervention where students could indicate what their main issue with learning-journal-writing was may have also let them feel acknowledged. It may have allowed them to understand that other students may experience similar issues, but overcome them. This social aspect is important for learners (Schunk, 1987; Friedrich and Mandl, 1997; Endres, in press), and could have led to an increase of the intrinsic value of the task.

Belonging to the intervention group also had a significant effect on the utility value, but this was likely due to the selection of students with low levels of motivation for the motivational intervention. Students who rated their utility value as low were categorized as at-risk and invited to participate in the intervention. Our intervention does not seem to have improved the utility value associated with learning-journal-writing.

However, our sample size for the at-risk group was quite small, and a selection bias is possible as only 43.5% of students considered at-risk actually completed the intervention. Conceivably, only at-risk students with enough motivation for learning-journal-writing participated in the intervention, as they might have already perceived some utility of the learning approach used here. These findings thus have to be interpreted with caution. However, we found no differences for the motivational items before the onset of the intervention between at-risk students who completed the intervention and those who did not. A selection bias based on students' motivation is therefore unlikely to have influenced our results.

4.3. Implications for other SRL trainings

The combination of the computer-based learning environment and the Freiburg Self-Regulated-Journal-Writing Approach, together with the peer-feedback, has been successful in supporting students. Other SRL trainings could match the general structure used here: An introductive learning session or environment that teaches SRL strategies and conditional knowledge for when, why and how to use them, opportunities for

practicing the application of these strategies throughout the semester, and continuous feedback offered to learners. This combination, fostering SRL skills as well as conditional knowledge and self-efficacy associated with SRL strategies, seemed to motivate students throughout the entire semester. As one goal of SRL trainings is to avoid students' dropout and to increase effort associated with learning, future SRL trainings should aim to incorporate components that foster the same processes as shown in the current study.

Another issue for future trainings is to include prompts about the personal relevance of the factual content, which could increase students' value associated with the SRL training (Schmidt et al., 2012). Personal relevance and utility prompts have been shown to increase motivation and learning outcomes (Wäschle et al., 2015). Other SRL trainings built using the same structure should identify ways of making their training contents personally relevant to learners, for example by using prompts or by showing the application of strategies using content knowledge that is interesting for the target group.

4.4. Limitations and future studies

As we conducted a field study, we could not control for the influence of the topic of the learning journals on students' motivation, as the topics were covered in the order used in the corresponding lecture. Previous studies suggest that a topic's personal relevance or utility can increase the content-related motivation and also the acceptance of learning-journal-writing (Schmidt et al., 2012; Wäschle et al., 2015). Topics that students find personally relevant may lead to a higher self-efficacy and motivation overall, as students may find it easier to connect these topics to their own experiences (elaboration strategy). Future studies should therefore measure the personal relevance that students associate with the different topics to further support the SRL training, or randomize the topics covered in the learning journals.

Additionally, in anecdotal reports, our students indicated a high uncertainty with implementing learning strategies at the start of the SRL training. To address this issue, cognitive modeling could be used to show how a learning journal should be written (Schunk and Hanson, 1985; Dinsmore, 2017). Explicitly showing how strategies are applied in a learning journal, what principles are used, and what is expected of the students could increase the acquisition of skills needed to write a good learning journal, and support students' self-efficacy.

Our study used a combination of components, which together supported students' motivation. However, it is unclear how either component on its own (learning environment teaching conditional knowledge or guided peer-feedback system) or their interaction influence students' motivation specifically, and how individual students respond to these components. As our students had to pass the learning journals to pass the course, we wanted to employ the best possible option. Therefore, we did not experimentally vary the components to investigate their influence. However, future studies should look at how each component influences motivational variables of different students, and whether the components should be combined or used adaptively for each individual student. This approach could support future SRL trainings by making them more adaptive to individual students' needs.

4.5. Conclusion

Next, to the already well-investigated cognitive benefits of the Freiburg Self-Regulated-Journal-Writing Approach, which may lead to a motivational decrease, our study shows that the enriched approach can foster students' SRL skills while also maintaining their motivation over the course of the semester. Our optional intervention led to an increase in the intrinsic value of at-risk students. While further research should optimize the current approach, we were able to show that our combination of teaching learning strategies in the computer-based learning environment, allowing students to implement these strategies using the Freiburg Self-Regulated-Journal-Writing Approach, and giving the opportunity of feedback using a guided peer-feedback system offers students a promising opportunity for increasing their SRL skills when starting their studies. This approach could be adopted for future SRL training programs and adapted for specific courses of study.

Data availability statement

The datasets presented in this study can be found online via the following link: https://osf.io/nmj8z/?view_only=e2672d374a604a7d8552f1fc88fce30f.

Ethics statement

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

NU-L, IG-F, and AR: contributed to the conception and design of the study and collected data. NU-L and TE: performed the statistical analysis. NU-L: wrote the first draft of the manuscript. All authors contributed to manuscript revision, read, and approved the submitted version.

Funding

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/feduc.2022.1067347/full#supplementary-material

References

Atkinson, J. W. (1957). Motivational determinants of risk-taking behavior. *Psychol. Rev.* 64, 359–372. doi: 10.1037/h0043445

Bandura, A. (1977). Self-efficacy: toward a unifying theory of behavioral change. *Psychol. Rev.* 84, 191–215. doi: 10.1037/0033-295X.84.2.191

Barron, K. E., and Hulleman, C. S. (2015). Expectancy-value-cost model of motivation. *Int. Encycl. Soc. Behav. Sci.on* 2017, 503–509. doi: 10.1016/B978-0-08-097086-8.26099-6

Biwer, F., de Bruin, A. B. H., Schreurs, S., and Oude Egbrink, M. G. A. (2020a). Future steps in teaching desirably difficult learning strategies: reflections from the study smart program. *J. Appl. Res. Mem. Cogn.* 9, 439–446. doi: 10.1016/j.jarmac.2020.07.006

Biwer, F., Oude Egbrink, M. G. A., Aalten, P., and de Bruin, A. B. H. (2020b). Fostering effective learning strategies in higher education – a mixed-methods study. *J. Appl. Res. Mem. Cogn.* 9, 186–203. doi: 10.1016/j.jarmac.2020.03.004

Bjork, R. A. (1970). "Repetition and rehearsal mechanisms in models for short-term memory," in *Models of human memory*. ed. D. A. Norman (New York: Academic Press).

Brown, A. L., and Palincsar, A. (1982). Inducing strategic learning from texts by means of informed, self-control training. *Topics Learn. Learn. Disabil.* 2, 1–17.

Bürgermeister, A., Glogger-Frey, I., and Saalbach, H. (2021). Supporting peer feedback on learning strategies: effects on self-efficacy and feedback quality. *Psychol. Learn. Teach.* 20, 383–404. doi: 10.1177/14757257211016604

Carpenter, S. K., Pan, S. C., and Butler, A. C. (2022). The science of effective learning with spacing and retrieval practice. *Nat. Rev. Psychol.* 1, 496–511. doi: 10.1038/s44159-022-00089-1

Dignath, C., and Büttner, G. (2018). Teachers' direct and indirect promotion of self-regulated learning in primary and secondary school mathematics classes – insights from video-based classroom observations and teacher interviews. *Metacognition Learning* 13, 127–157. doi: 10.1007/s11409-018-9181-x

De Bruin, A. B. H., Roelle, J., Carpenter, S. K., Baars, M., Ackerman, R., Biwer, F., et al. (2020). Synthesizing cognitive load and self-regulation theory: a theoretical framework and research agenda. *Educ. Psychol. Rev.* 32, 903–915. doi: 10.1007/s10648-020-09576-4

DGPs (2016). Berufsethische Richtlinien Des Berufsverbandes Deutscher Psychologinnen Und Psychologen e.V. Und Der Deutschen Gesellschaft Für Psychologie e.V Available at: https://www.dgps.de/die-dgps/aufgaben-und-ziele/berufsethische-richtlinien (Accessed October 10, 2022).

Dinsmore, D. (2017). *Strategic Processing in Education*. New York: Routledge.

Dresel, M., Schmitz, B., Schober, B., Spiel, C., Ziegler, A., Engelschalk, T., et al. (2015). Competencies for successful self-regulated learning in higher education: structural model and indications drawn from expert interviews. *Stud. High. Educ.* 40, 454–470. doi: 10.1080/03075079.2015.1004236

Eccles, J. S., and Wigfield, A. (2002). Motivational beliefs, values, and goals. *Annu. Rev. Psychol.* 53, 109–132. doi: 10.1146/annurev.psych.53.100901.135153

Endres, T. (in press). "Adaptive blended learning to foster self-regulated learning - a principle-based explanation of a self-regulated learning training" *Society for the Teaching of Psychology: In their own words: What scholars want you to know about why and how to apply the science of learning in your academic setting*. eds. C. E. Overson, C. M. Hakala, L. L. Kordonowy and V. A. Benassi.

Endres, T., Leber, J., Böttger, C., Rovers, S., and Renkl, A. (2021). Improving lifelong learning by fostering students' learning strategies at university. *Psychol. Learn. Teach.* 20, 144–160. doi: 10.1177/1475725720952025

Endres, T., Weyreter, S., Renkl, A., and Eitel, A. (2020). When and why does emotional design foster learning? Evidence for situational interest as a mediator of increased persistence. *J. Comput. Assist. Learn.* 36, 514–525. doi: 10.1111/jcal.12418

Friedrich, H. F., and Mandl, H. (1997). "Analyse und Förderung selbstgesteuerten Lernens", in *Psychologie Der Erwachsenenbildung*. eds. F. E. Weinert and H. Mandl (Göttingen, Germany: Hogrefe).

Hattie, J., and Timperley, H. (2007). The power of feedback. *Rev. Educ. Res.* 77, 81–112. doi: 10.3102/003465430298487

Hübner, S., Nückles, M., and Renkl, A. (2010). Writing learning journals: instructional support to overcome learning-strategy deficits. *Learn. Instr.* 20, 18–29. doi: 10.1016/j.learninstruc.2008.12.001

Huisman, B., Saab, N., van den Broek, P., and van Driel, J. (2019). The impact of formative peer feedback on higher education students' academic writing: a meta-analysis. *Assess. Eval. High. Educ.* 44, 863–880. doi: 10.1080/02602938.2018.1545896

Huisman, B., Saab, N., van Driel, J., and van den Broek, P. (2018). Peer feedback on academic writing: undergraduate students' peer feedback role, peer feedback perceptions and essay performance. *Assess. Eval. High. Educ.* 43, 955–968. doi: 10.1080/02602938.2018.1424318

Hulleman, C. S., Barron, K. E., Kosovich, J. J., and Lazowski, R. A. (2016). "Student motivation: current theories, constructs, and interventions within an expectancy-value framework," in *Psychosocial Skills and School Systems in the 21st Century - Theory, Research, and Practice*. eds. A. A. Lipnevich, F. A. Preckel and R. D. Roberts (Berlin: Springer).

Kosovich, J. J., Flake, J. K., and Hulleman, C. S. (2017). Short-term motivation trajectories: a parallel process model of expectancy-value. *Contemp. Educ. Psychol.* 49, 130–139. doi: 10.1016/j.cedpsych.2017.01.004

McCrindle, A. R., and Christensen, C. A. (1995). The impact of learning journals on metacognitive and cognitive processes and learning performance. *Learn. Instr.* 5, 167–185. doi: 10.1016/0959-4752(95)00010-Z

Muis, K. R. (2007). The role of epistemic beliefs in self-regulated learning. *Educ. Psychol.* 42, 173–190. doi: 10.1080/00461520701416306

Nicholls, M. E. R., Loveless, K. M., Thomas, N. A., Loetscher, T., and Churches, O. (2015). Some participants may be better than others: sustained attention and motivation are higher early in the semester. *Q. J. Exp. Psychol.* 68, 10–18. doi: 10.1080/17470218.2014.925481

Nückles, M., Hübner, S., Dümer, S., and Renkl, A. (2010). Expertise reversal effects in writing-to-learn. *Instr. Sci.* 38, 237–258. doi: 10.1007/s11251-009-9106-9

Nückles, M., Hübner, S., and Renkl, A. (2009). Enhancing self-regulated learning by writing learning protocols. *Learn. Instr.* 19, 259–271. doi: 10.1016/j.learninstruc.2008.05.002

Nückles, M., Roelle, J., Glogger-Frey, I., Waldeyer, J., and Renkl, A. (2020). The self-regulation-view in writing-to-learn: using journal writing to optimize cognitive load in self-regulated learning. *Educ. Psychol. Rev.* 32, 1089–1126. doi: 10.1007/s10648-020-09541-1

Paris, S. G., and Jacobs, J. E. (1984). The benefits of informed instruction for children's reading awareness and comprehension skills. *Child Dev.* 55, 2083–2093. doi: 10.2307/1129781

Paris, S. G., Lipson, M. Y., and Wixson, K. K. (1983). Becoming a strategic reader. *Contemp. Educ. Psychol.* 8, 293–316. doi: 10.1016/0361-476X(83)90018-8

Rowland, C. A. (2014). The effect of testing versus restudy on retention: a meta-analytic review of the testing effect. *Psychol. Bull.* 140, 1432–1463. doi: 10.1037/a0037559

Schmidt, K., Maier, J., and Nückles, M. (2012). Writing about the personal utility of learning contents in a learning journal improves learning motivation and comprehension. *Educ. Res. Int.* 2012, 1–10. doi: 10.1155/2012/319463

Schoppek, W. (2015). Multilevel analysis or analysis of variance? A simulation based comparison of methods for analyzing experiments in school settings. *Zeitschrift Fur Entwicklungspsychologie Und Padagogische Psychologie* 47, 199–209. doi: 10.1026/0049-8637/a000136

Schunk, D. H. (1987). Peer models and children's behavioral change. *Rev. Educ. Res.* 57, 149–174. doi: 10.3102/00346543057002149

Schunk, D. H., and Hanson, A. R. (1985). Peer models: influence on children's self-efficacy and achievement. *J. Educ. Psychol.* 77, 313–322. doi: 10.1037//0022-0663.77.3.313

Udvardi-Lakos, N., Glogger-Frey, I., Endres, T., and Renkl, A.. (2021). "Dataset for study engaging in writing to learn - increasing the motivation during a long-term self-regulated learning training." Open Science Framework. Available at: https://osf.io/nmj8z/?view_only=e2672d374a604a7d8552f1fc88fce30f (Accessed on June 30, 2022).

Van Zundert, M., Sluijsmans, D., and van Merriënboer, J. (2010). Effective peer assessment processes: research findings and future directions. *Learn. Instr.* 20, 270–279. doi: 10.1016/j.learninstruc.2009.08.004

Wäschle, K., Gebhardt, A., Oberbusch, E.-V., and Nückles, M. (2015). Journal writing in science: effects on comprehension, interest, and critical reflection. *J. Writ. Res.* 7, 41–64. doi: 10.17239/jowr-2015.07.01.03

Weinstein, C. E., and Mayer, R. E. (1986). "The teaching of learning strategies," in *Handbook of research on teaching*. ed. C. M. Wittrock (London: Macmillan).

Wernersbach, B. M., Crowley, S. L., Bates, S. C., and Rosenthal, C. (2014). Study skills course impact on academic self-efficacy. *J. Dev. Educ.* 37, 14–33.

Wigfield, A., and Eccles, J. S. (2000). Expectancy-value theory of achievement motivation. *Contemp. Educ. Psychol.* 25, 68–81. doi: 10.1006/ceps.1999.1015

Zimmermann, B. J. (2000). "Attaining self-regulation: a social cognitive perspective" in *Handbook of self-regulation*. eds. M. Bokaerts, P. R. Pintrich and M. Zeidner (San Diego, CA: Academic Press).