

A systematic review of interventions targeting self-regulation in higher education

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### **Perspective**

Self-regulated learning involves the use of metacognitive, motivational and behavioral strategies to achieve goals (Cleary & Zimmerman, 2004). Self-regulated learners may use cognitive strategies to understand and remember material better, metacognitive strategies to regulate and control their cognition, and behavioral strategies to regulate their external environment and own attention (de Boer, Donker, Kostons, & van der Werf, 2018; Donker, de Boer, Kostons, Dignath van Ewijk, & van der Werf, 2014; Pintrich, Smith, Garcia, & McKeachie, 1991). Motivational regulation and emotional regulation strategies may also be used by learners (Gross, 2013; Smit, de Brabander, Boekaerts, & Martens, 2017; Wolters & Benzoni, 2013).

Although as children get older they are more likely to make use of effective strategies (Dignath, Buettner, & Langfeldt, 2008), intervention may still be needed (Pintrich, 1999). Due to the number of intervention approaches that have been used and evaluated in previous research, several systematic reviews and meta-analyses of the effectiveness of interventions have been conducted. However, the majority of these have

focused on primary and secondary school learners (e.g. de Boer et al., 2018; Dignath et al., 2008; Dignath & Büttner, 2008), with, to our knowledge, only one systematic review of interventions in higher education (de Bruijn-Smolders, Timmers, Gawke, Schoonman, & Born, 2016). Yet, de Bruijn-Smolders et al.'s (2016) review only considered the impact of interventions on metacognitive and behavioral components (and motivational beliefs rather than regulation), despite the fact most self-regulation models also incorporate cognitive and emotional components (Panadero, 2017).

### **Objectives**

The aim of this review was to systematically identify the different interventions that have been used to facilitate higher education students' self-regulation. We addressed the following research questions:

1. What type of interventions have been used in attempts to facilitate students' self-regulation?
2. Which components of self-regulation (cognitive, metacognitive, behavioral, emotional, and motivational) have been targeted by these interventions?

### **Methods**

We followed the guidelines set out in the PRISMA-P statement for reporting systematic review protocols (Moher et al., 2015) while preparing the protocol for this qualitative synthesis, and the PRISMA statement (Moher et al., 2009) for reporting systematic reviews while writing this paper. We searched PsycINFO and ERIC databases for peer reviewed sources published in the English language between 1<sup>st</sup> January 2000 and 31<sup>st</sup> August 2018. The titles, abstracts and keywords needed to include *self regulat\** or *metacognit\** and at least one of the following terms: *student\**, *trainee\**, *learner\**,

*\*graduate\*, teacher\*, lecturer\*, professor\*, instructor\*, or tutor\**. Limiters were applied to ERIC and PsycINFO to only include studies with adult participants (18 years and older), at a higher education level, and classified as being cognitive, educational, experimental or about learning and motivation.

After removal of duplicates, the titles and abstracts of 3,221 records were independently screened against the eligibility criteria by two researchers. Disagreements about eligibility were discussed until a consensus was reached, which led to 622 outputs deemed to potentially meet the inclusion criteria. We were able to obtain the full-texts for 618 of these outputs, so these were independently screened against the inclusion criteria by the same two researchers and disagreements about eligibility were again discussed until we determined that 230 studies should be included in the qualitative synthesis. This process is depicted in in the PRISMA flow chart in Figure 1.

## **Results**

Using a standardized spreadsheet, data was extracted for each eligible study. After extracting data about each intervention, similar approaches were then grouped together and a classification name was given for each grouping based on a detailed reading of what each intervention involved. In only a few cases, more than one intervention was tested, so we only classified the most prominent approach. The components of self-regulation measured within each study were categorized into *cognitive, metacognitive, behavioral, emotional, and motivational*, or in cases where a composite measure of self-regulation was used (or where it was not otherwise specified), *general self-regulation*. In most cases, studies measured multiple components of self-regulation as targets of each intervention. See Table 1 for a summary of intervention classifications, description of

what each intervention type involves, and the components of self-regulation targeted by each intervention.

### **Types of interventions**

As Table 1 shows, 13 intervention types were classified and an ‘other’ category was formed for interventions that could not be grouped with others. Below we have discussed the three intervention types that were reported by most studies in more detail along with examples from some of those studies.

**Scaffolds/Prompts.** The most common type of intervention involved scaffolds or prompts (58 studies). All components of self-regulation were targeted in at least one of these studies, with metacognitive processes being most prevalent, followed by cognitive processes. Bixler and Land (2010) embedded cognitive and metacognitive prompts into an online learning environment that students were using to solve an ill-structured problem. Windows would pop-up with question prompts to encourage students to think about whether they could, for example, elaborate more in their answers (cognitive prompt) or reflect more on the processes they used (metacognitive prompt). The treatment group receiving the prompts displayed significantly more metacognitive strategies in the form of higher monitoring and evaluating scores on a rubric.

**Strategy training programs.** This type of intervention was reported in 50 studies and, again, there were examples in which all components of self-regulation were targeted. Engin, Dikbayir, and Genç (2017) reported on a 10-week program of teaching learning strategy activities to trainee teachers, including attention and rehearsal strategies.

Analyses of the difference between pre- and post-training self-regulation measures

showed an increase in rehearsal and elaboration strategies (cognitive strategies), metacognitive strategies, and peer learning (behavioral strategies).

**Collaboration and discussion.** Activities involving students working and reflecting with others were reported by 17 studies, and all aspects of self-regulation were targeted apart from motivational regulation. Using group-based assessment in a marketing course, Bicen and Laverie (2009) got students to work in teams to produce a case study. Activities involved students taking on different roles within their group, giving and receiving peer feedback, and making changes based on this and their tutor's feedback as part of an ongoing dialogue. They saw significant increases in students' cognitive and metacognitive strategies.

### **Next Steps**

These studies will now be included in a meta-analysis to compare the overall effects of each intervention type (i.e. studies will be put into subgroups in the analysis based on the classifications described above) on self-regulation outcomes. We will also include these studies in a separate meta-analysis with performance as the outcome variable (where a performance measure has been included in the study). An assessment of the quality of evidence in each study will also be undertaken using the Grading of Recommendations, Assessment, Development and Evaluation (GRADE) methodology (Guyatt et al., 2008). We will conduct sensitivity analyses to determine whether the removal of studies deemed to be of low or insufficient quality will affect any findings about the effectiveness of each intervention.

### **Scholarly Significance**

This is, to our knowledge, the first systematic review of interventions targeting all of the different components of self-regulation emphasized in major self-regulation models. The findings provide educators with some guidance as to the types of interventions used to facilitate self-regulation, and which components they may target. Scaffolds/prompts and strategy training programs were the most commonplace interventions reported, accounting for 47% of all the interventions included in the synthesis. Metacognitive processes are clearly the main component of self-regulation targeted by interventions; 81% of studies included in the synthesis measured metacognitive processes as at least one of their outcomes, with cognitive processes being the next highest, appearing in only 33% of studies, and behavioral processes being targeted by interventions in 30% of studies. It is not clear whether the interventions reported also had effects on other components of self-regulation that were not measured, but the findings do raise a question about why metacognitive processes are targeted so much more than other components of self-regulation, particularly considering that metacognitive self-regulation has only been found to be a weak to moderate predictor of learning compared to other components (Broadbent & Poon, 2015; Sitzmann & Ely, 2011). There are two possible explanations for this emphasis on metacognitive self-regulation. Firstly, the most common intervention types (scaffolds/prompts) involve metacognitive activities built into their design (i.e. they are most likely to prompt students to self-question and self-reflect, rather than engage them in behavioral processes, such as peer learning). Secondly, there are many measures of self-regulation that focus on

metacognition, such as the Metacognitive Awareness Inventory (Schraw & Dennison, 1994), so this may lead to this component being disproportionately focused on.

Another finding of interest is the fact that emotional and motivational regulation were targeted by only six and seven studies each, respectively. It is possible that emotional regulation interventions are mostly carried out in a non-learning context (i.e. they may be carried out as part of health-related interventions). If so, these studies would not have been included as part of the search strategy for the current review. However, even if this was the case, this does suggest that interventions for regulating emotions related to learning are not very commonplace, despite the fact that emotions play a role in all major self-regulation models (Panadero, 2017). It has been highlighted that emotional regulation is an area that has received relatively little attention in research (Webster & Hadwin, 2015), so the current findings seem to confirm this; if there is little research on emotional regulation it is unsurprising that few interventions appear to target it. Webster and Hadwin (2015) do point towards some cognitive, metacognitive and behavioral strategies that undergraduates appeared to use while regulating their emotions. For example, they found that some students would make study schedules (a metacognitive strategy) to deal with negative emotions like boredom and anxiety. Thus, it may be the case that when interventions target these components of self-regulation they are also targeting emotional regulation.

Like emotional regulation, motivational regulation has been explored far less in previous research than cognitive and metacognitive components of self-regulation (Kim, Brady, & Wolters, 2018). Therefore, this may account for the dearth of interventions targeting this component. While it has been noted that in higher education motivation is

likely to play a particularly large role in the likelihood that students will make use of self-regulated learning strategies (Panadero, 2017), motivation is distinct from motivational regulation because “strategies for regulating motivation ultimately are meant to affect students’ willingness to process information, to construct meaning, or to continue working” (Wolters, 2003, p. 192). Again, as with emotional regulation, it may be the case that motivational regulation is subsumed within other components of self-regulation. For example, Wolters (2003) describes environmental structuring (usually conceptualized as a behavioral or resource management strategy) and even emotional regulation as motivational regulation strategies. A corollary of these findings is that there clearly needs to be more research that specifically considers whether important components of self-regulation are being missed with current intervention approaches. Future research on interventions may benefit from including measures of emotional and motivational regulation as distinct constructs from other components of self-regulation.



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Table 1. *Classification of interventions, self-regulation components targeted, and the number of studies reporting these interventions and measuring these components*

Intervention type	Description of intervention type	Self-regulation components targeted						Total studies reporting this intervention
		General self-regulation	Cognitive	Metacognitive	Behavioural	Emotional	Motivational	
Scaffolds/prompts	Students' learning is supported by guidance that encourages them to reflect on their choices	7	22	47	13	1	2	58
Strategy training programs	Students are taught either face-to-face or via the web about specific self-regulation strategies and how to use them	6	15	44	13	1	1	50
Collaboration and discussion	Students engage in a dialogic interaction with peers and/or their tutor, involving reflection and feedback	2	4	13	3	1	0	17
Problem-based learning	Students work in groups and follow a number of steps to analyse an open-ended issue and arrive at a solution	4	5	11	5	0	0	15
Reflective Journals	Students write reflections about learning situations regularly and collate these over time	1	7	12	9	0	1	14
Learning aids	Students use tools that encourage them to organise and make sense of their learning	2	3	11	3	0	0	13
Online environments	Students engage in study activities delivered completely online with no specific scaffolds	1	5	9	6	0	1	11
Academic and professional development	Students receive academic advice or learning/study skills support, but not training on self-regulation strategies specifically	2	2	7	4	0	0	10

Table 1. (continued)

Intervention type	Description of intervention type	Self-regulation components targeted						Total studies reporting this intervention
		General self-regulation	Cognitive	Metacognitive	Behavioural	Emotional	Motivational	
Electronic performance support systems	Students use computer-based environments that have real-time performance-related analytics	1	5	7	7	0	0	10
Portfolio assessments	Students complete a variety of small formative assessments that are subsequently collated into a single summative submission	2	2	6	2	1	0	8
Flipped classroom	The usual classroom content is made available for students to cover in their own time, and class time is instead used for active learning tasks	1	2	6	3	0	0	7
Electronic feedback devices	Students use electronic devices in order to engage with class activities	0	1	4	0	0	0	4
Peer tutoring	Students provide other students with direct teaching support	0	1	4	0	0	0	4
Self-assessment tools	Students use tools that facilitate their self-monitoring and self-evaluation	1	0	3	0	2	2	4
Other	Remaining interventions that were too heterogeneous to be grouped	2	2	3	1	0	0	5
Total studies measuring self-regulation component		32	76	187	69	6	7	

*Note.* Most of the papers targeted more than one component of self-regulation, so the values in each cell do not sum to the total number of studies in the far right column.

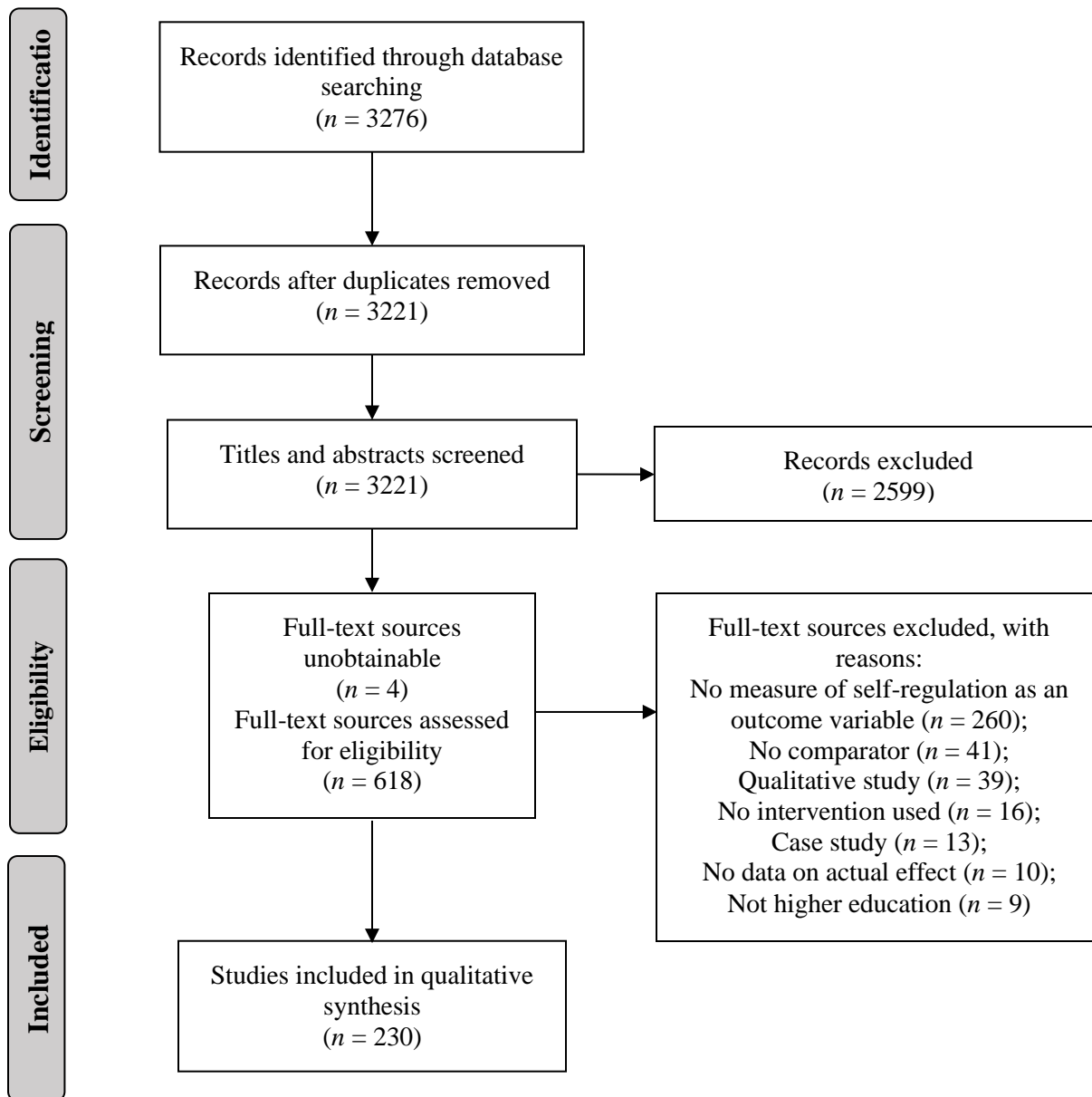


Figure 1. PRISMA flow diagram of literature searching and screening process.