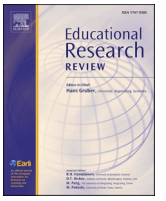
Educational Research Review 45 (2024) 100629

Contents lists available at ScienceDirect

Educational Research Review

journal homepage: www.elsevier.com/locate/edurev



Review

Self-regulated learning strategies in continuing education: A systematic review and meta-analysis

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ARTICLE INFO

Keywords:
Continuing education
Self-regulated learning
Systematic review
Meta-analysis

ABSTRACT

Self-regulated learning (SRL) has been considered a key competence for continuing education (CE). The present systematic review and meta-analysis investigated factors associated with learners' use of SRL strategies in CE. Synthesizing a total number of 58 studies, we identified learning process-related, learner-related, CE-related, and work-related factors associated with SRL strategies in CE. Three-level random-effects meta-analyses revealed significant relationships between SRL strategies and achievement motivation ($r = .30$), learning performance ($r = .36$), learner engagement ($r = .39$), learner satisfaction ($r = .30$), avoidance behavior ($r = -.14$), prior knowledge ($r = .05$), CE experience ($r = .08$), organizational learning culture ($r = .26$), job control ($r = .28$), and job demands ($r = .21$). Operationalization of variables as well as setting and work-relatedness of the CE activity were identified as moderators. Our investigations help understand the nature of SRL in CE and provide a sound basis for designing interventions to support SRL in CE. Future research should identify moderators to explain heterogeneity in effect sizes.

1. Introduction

Due to rapid social and technological changes in today's (working) world, continuing education (CE) is becoming increasingly important. Individuals are constantly required to participate in CE activities and to acquire new knowledge, skills, and competences to successfully adapt to these changes (Cuyvers et al., 2021; Kittel, Kunz, & Seufert, 2021; Manuti, Pastore, Scardigno, Giancaspro, & Morciano, 2015). CE is usually characterized by high learner autonomy and requires learners to engage in self-regulated learning (SRL) processes (Nawrot & Doucet, 2014; Sitzmann & Ely, 2011). SRL describes active and dynamic processes whereby learners monitor and control their own cognitions, affects, and behaviors to achieve personal learning goals (Pintrich, 2000; Zimmerman & Schunk, 2011). When engaging in SRL, learners use various strategies to optimize their learning process and to achieve their goals. These SRL strategies include cognitive (e.g., rehearsal, elaboration), metacognitive (e.g., planning, monitoring), and resource management (e.g., time management, help seeking) strategies (Pintrich, Smith, Garcia, & McKeachie, 1991, 1993).

SRL strategies have been considered key competences for CE and have been linked to learning performance in empirical studies (Chaker & Impedovo, 2021; Haemer, Borges-Andrade, & Cassiano, 2017). However, the nature of SRL in CE still remains unclear, as comprehensive systematic reviews and meta-analyses investigating the factors triggering and inhibiting learners' use of SRL strategies as well as the effects of SRL strategies in CE are scarce. Systematic reviews on SRL in CE have primarily focused on Massive Open Online Courses (MOOCs) and summarized SRL theories (e.g., Alonso-Mencía et al., 2020), SRL strategies (e.g., Lee, Watson, & Watson, 2019),

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https://doi.org/10.1016/j.edurev.2024.100629
Received 11 May 2023; Received in revised form 1 July 2024; Accepted 13 August 2024
Available online 14 August 2024

SRL measurement instruments (e.g., Cerón et al., 2020), and SRL interventions (e.g., Lee et al., 2019) studied in the context of MOOCs. A comprehensive systematic review investigating potential antecedents and outcomes of SRL strategies in CE and focusing on other types of CE than MOOCs is lacking. CE can occur through different types of learning activities (e.g., online vs. face-to-face, work-related vs. non-work-related, formal vs. informal learning activities), which differ in their nature of learning and, therefore, might impact SRL (Beishuizen & Steffens, 2011; Schiersmann, 2007; Tynjälä, 2008, 2013).

Moreover, meta-analyses quantifying the strength of the relationships between SRL strategies and potential antecedents and outcomes in CE are scarce. While SRL strategies have been extensively researched in meta-analyses focusing on K-12 (e.g., Dent & Koenka, 2016; Li, Ye, Tang, Zhou, & Hu, 2018) and higher education (e.g., Broadbent & Poon, 2015; Theobald, 2021), Sitzmann and Ely's (2011) meta-analysis is the only meta-analysis on SRL strategies that included studies focusing on CE. Sitzmann and Ely (2011) found positive relationships between several SRL strategies and achievement motivation as well as learning performance. However, they did not investigate the relationships between SRL strategies and other factors that may be associated with SRL strategies in CE (e.g., learner satisfaction, job demands; K. Li, 2019; Raemdonck, Gijbels, & Van Groen, 2014). Moreover, Sitzmann and Ely's meta-analysis did not focus on CE exclusively, and the majority of the included studies (82%) focused on higher education. Thus, the informative value for CE is limited, as CE differs from higher education in several aspects (e.g., the relevance of informal learning activities, learners' professional situation), which might impact SRL (Eriksson, Adawi, & Stöhr, 2017; Kittel et al., 2021; Knowles, Holton, & Swanson, 2012). Further, only work-related, formal CE was considered, excluding all types of non-work-related and informal learning activities (Sitzmann & Ely, 2011).

Accordingly, a comprehensive systematic review and meta-analysis investigating factors associated with SRL strategies in CE is expected to help reveal the nature of SRL in CE and identify the most important SRL strategies for different types of CE. Such insights may help understand how learners can best apply SRL strategies, identify conditions that require SRL support, and design interventions to support SRL in CE (Broadbent & Poon, 2015; Tang, 2021). Therefore, our systematic review and meta-analysis aim to identify factors associated with learners' use of SRL strategies in CE as well as investigate the strength and potential moderators of the underlying relationships.

2. Continuing education

CE is a broad term that encompasses all learning activities that are distinct from professional apprenticeships, K-12, and higher education (Demary, Malin, Seyda, & Werner, 2013; *Further and Higher Education Act*, 1992). CE aims to develop or renew knowledge (i.e., cognitive representations of learning contents; Carter, 1985; Winterton, Le Deist, & Stringfellow, 2005), skills (i.e., abilities to perform a specific task; Attewell, 1990; Carter, 1985), and competences (i.e., knowledge skills, behaviors, and attitudes necessary to be successful in a job or particular area; Le Deist & Winterton, 2005) after the completion of an initial phase of education (Demary et al., 2013; Schiersmann, 2007). Higher education institutions are increasingly involved in the design of CE activities by offering MOOCs or professional certificate programs (Agyepong & Okyere, 2018; Wulf, Blohm, Leimeister, & Brenner, 2014), which differ from traditional higher education in that they do not lead to an undergraduate or consecutive graduate degree and have either no or special admission regulations (Heidelberg University, 2023; Versuti et al., 2020; Wulf et al., 2014).

CE can be work-related or non-work-related (Demary et al., 2013; *Further and Higher Education Act*, 1992). Learners engaging in work-related CE aim at developing or renewing knowledge, skills, and competences that are relevant for their job position. Work-related CE may (but does not have to be) financially supported by the employer and be accounted as part of the work (Kyndt & Baert, 2013; Schiersmann, 2007). In contrast, non-work-related CE focuses on knowledge, skills, and competences that are not directly linked to a specific job position (Demary et al., 2013; Schiersmann, 2007). Both work-related and non-work-related CE can occur through formal, non-formal, and informal learning activities. Formal CE refers to organized learning activities that are regulated by law and may lead to a state-approved certificate (Misko, 2008; Schumacher, 2018). Non-formal CE comprises all other forms of organized CE activities that are not regulated by law (Radcliffe & Colletta, 1989; Schumacher, 2018). Informal CE refers to unorganized and sometimes unconscious and unintended learning activities that occur through experiences in daily (work) life (Eraut, 2004; Schiersmann, 2007; Schumacher, 2018).

3. Self-regulated learning and self-regulated learning strategies

According to SRL theories, learners are active participants in their own learning process and potentially able to monitor and control certain aspects of their learning (Pintrich, 2000; Zimmerman & Schunk, 2011). Several authors have suggested that SRL consists of at least three cyclical phases. First, in the *forethought phase*, learners analyze the learning task, set learning goals, and build a plan to approach these goals. Second, in the *performance phase*, learners carry out the plan they created beforehand as well as monitor and control their learning progress. Third, in the *self-reflection phase*, learners evaluate their overall learning performance in relation to their learning goals. This evaluation may lead them to adapt their strategies for future learning sessions and may influence subsequent forethought phases (Panadero, 2017; Pintrich, 2000; Winne & Hadwin, 1998; Zimmerman, 2000).

All learners self-regulate their learning process to some degree (Winne, 2011, 2022). However, good self-regulators are distinguished by their effective use of SRL strategies (Pintrich, Smith, Garcia, & McKeachie, 1993; Zimmerman, 1990). SRL strategies have been conceptualized differently across SRL theories, but they can broadly be classified into cognitive, metacognitive, and resource management strategies (Pintrich et al., 1993; Theobald, 2021). *Cognitive strategies* facilitate the processing of information from learning materials (Pintrich et al., 1991, 1993; Wild & Schiefele, 1994; Winne, 2011). *Metacognitive strategies* describe second-order cognitions that help learners monitor and control their cognition and application of cognitive strategies. Metacognitive strategies involve goal

setting and planning as well as monitoring, evaluating, and adjusting one's learning behavior. *Resource management strategies* summarize strategies for regulating other internal and external resources (e.g., time, effort) besides cognition (Pintrich, 1999; Pintrich et al., 1991, 1993; Theobald, 2021; Wild & Schiefele, 1994). Table 1 provides an overview of different SRL strategies identified in previous literature and studied in the present systematic review and meta-analysis.

Previous systematic reviews and meta-analyses have identified potential antecedents and outcomes of SRL in K-12 (e.g., Dent & Koenka, 2016; Fong et al., 2021; J. Li et al., 2018) and higher education (e.g., Broadbent & Poon, 2015; Panadero, Jonsson, & Botella, 2017; Zheng, Lajoie, & Li, 2023). For example, individual (e.g., reflective skills, emotions; van Houten-Schat et al., 2018; Zheng et al., 2023) and contextual (e.g., course characteristics, social support; Martínez-López, Nouws, Villar, Mayo, & Tinajero, 2023; Panadero et al., 2017) factors have been associated with SRL strategies in K-12 and higher education. Moreover, several meta-analyses have found positive associations between SRL strategies and learning performance in K-12 (e.g., J. Li et al., 2018) and higher education (e.g., Broadbent & Poon, 2015).

4. Self-regulated learning strategies in continuing education

Researchers have agreed that learning in CE is different than in K-12 and higher education (Knowles et al., 2012; Tynjälä, 2008; Wozniak, 2020). Therefore, the factors triggering or inhibiting SRL strategies, as well as the relevance of SRL in general and specific SRL strategies in detail, might differ between CE and K-12 as well as higher education. For example, learning in CE often clashes with professional and family commitments, resulting in less priority being given to learning (Eriksson et al., 2017; Schröer, Radunovic, & Völz, 2022). Therefore, specific SRL strategies such as time management should be especially important in CE to help learners balance learning with professional and family commitments (Kizilcec & Halawa, 2015; Nawrot & Doucet, 2014). Even though such conflicting commitments may also occur in K-12 and higher education, they are more prominent in CE. Learning is the main occupation of K-12 and full-time higher education students. Thus, learning tasks may be given higher priority than in CE, which usually happens besides the learners' main occupation (e.g., work; Eriksson et al., 2017; Schröer et al., 2022).

Moreover, learning in K-12 and higher education usually occurs through formal learning activities, whereas learning in CE often occurs through non-formal and informal learning activities in addition to formal learning activities (Schiersmann, 2007; Tynjälä, 2008). While some researchers have argued that the major assumptions of SRL theories might be equally applied to formal, non-formal, and informal learning activities (Kittel et al., 2021; Lee, Watson, & Watson, 2020), other researchers have argued that SRL strategies should play a more important role in informal learning activities due to their unstructured and unorganized nature (Beishuizen & Steffens, 2011).

Knowles et al. (2012) introduced adult learning theory to highlight that adult learners in CE differ from younger learners in K-12 and higher education. According to adult learning theory, learners in CE are distinguished by a strong need for self-direction. They want to be treated as responsible individuals being capable of controlling their own learning and resist when others try to force their wills upon them (Knowles, 1985; Knowles et al., 2012; Manning, 2007). Accordingly, in contrast to K-12 and higher education, learners in CE are usually given a higher degree of autonomy to decide when, how, and what they would like to learn (Sitzmann & Ely, 2011). Hence, learners in CE need to apply SRL strategies to deal with the autonomy they are granted (Jansen, van Leeuwen, Janssen, & Conjin, 2020; Sitzmann & Ely, 2011). However, in some cases of work-related CE, learning activities might also be mandatory and externally regulated by the employer. These learning activities are characterized by low degrees of learner autonomy (Hemmler, Rasch, & Ifenthaler, 2023), raising the question of whether SRL might play a different role in these types of CE.

Thus, the factors triggering, inhibiting, and interacting with SRL strategies in CE still remain unclear and need to be investigated in a comprehensive systematic review and meta-analysis. SRL theories have suggested that SRL results from an interaction between motivational states and behavioral variables related to the learning process, individual characteristics, and characteristics of the learning environment (Pintrich, 2000; Winne, 2011; Zimmerman, 1989, 2013). The learning environment in CE may be shaped by characteristics of the CE activity as well as learners' work environment (Alonso-Mencía et al., 2020; van Houten-Schat et al., 2018). Therefore, we suggest that learning process-related, learner-related, CE-related, and work-related factors may be associated with SRL strategies in CE.

4.1. Learning process-related factors

Learning process-related factors describe variables related to learners' behavior, motivational states, and performance during participation in a specific CE activity (Greene & Azevedo, 2007; Yau & Ifenthaler, 2020). In several SRL theories (e.g., Pintrich, 2000; Zimmerman & Schunk, 2007), learning process-related factors have been considered antecedents and outcomes of SRL strategies. For example, SRL strategies require time and effort (Zimmerman & Schunk, 2007). Therefore, achievement motivation has been considered a precondition for SRL strategies (Pintrich, 2000; Winne, 2011; Zimmerman & Schunk, 2007). Further, learning performance in CE relies on learners' ability to autonomously monitor and control their learning processes and resources, which is reflected by SRL strategies (Kittel et al., 2021; Pintrich, 2000).

In their systematic review, Lee et al. (2019) showed positive effects of SRL strategies on achievement motivation, learning performance, and goal achievement in MOOCs. Such relationships were also found in Sitzmann and Ely's (2011) meta-analysis focusing on higher education and work-related, formal CE. However, it remains unclear whether and to what extent these relationships also apply to other types of CE, as empirical primary studies focusing on different types of CE have shown a considerable variance of effect sizes (e.g., Chen & Jang, Lourenco & Ferreira, 2019; Jo et al., 2015; Littlejohn, Milligan, et al., 2016; Lourenco & Ferreira, 2019). Moreover, it remains unclear what other learning process-related factors are linked to SRL strategies in CE. Empirical primary studies

Table 1
Coded variables and intercoder reliability.

Variable	Codes	Description	Krippendorff's alpha
SRL strategies	**Cognitive strategies**		.78
	Rehearsal	Repeating learning contents over and over again to memorize information (Pintrich et al., 1991, 1993)	
	Elaboration	Connecting information from different sources, integrating information into existing knowledge structures (e.g., paraphrasing, creating analogies; Pintrich et al., 1991, 1993; Wild & Schiefele, 1994)	
	Organization	Transforming learning contents into a new structure that is easier to process (e.g., outlining, clustering; Pintrich et al., 1991, 1993; Wild & Schiefele, 1994)	
	Critical thinking	Applying learning contents to new situations or making critical judgements (Pintrich et al., 1991, 1993)	
	Other	Other measures of cognitive strategies (e.g., task strategies, analytical strategies; Vanslambrouck, Zhu, Pynoo, Lombaerts, et al., 2019; Warr & Bunce, 1995)	
	Metacognitive strategies		
	Goal setting and planning	Thinking about what needs to be learned, setting learning goals, and building a plan (e.g., a study schedule) to approach these goals (Theobald, 2021; Zimmerman & Martinez-Pons, 1986)	
	Self-monitoring	Self-observing the current learning progress, knowledge, or comprehension of the learning contents (Theobald, 2021)	
	Self-evaluation and reaction	Reflecting and assessing one's learning performance in relation to learning goals and adjusting one's learning behavior for future learning session (Pintrich et al., 1991, 1993; Theobald, 2021)	
	Self-satisfaction	Recognizing the intrinsic value of the current learning activity (e.g., its relation to long-term goals or personal interests; Fontana et al., 2015)	
	Metacognitive self-regulation	Composite score of metacognitive strategies including planning, monitoring, and regulating learning processes (Pintrich et al., 1991, 1993)	
	Resource management strategies		
	Time and study environment	Scheduling and managing one's learning time as well as organizing a quiet study environment that is free of distractions (Pintrich et al., 1991, 1993)	
	Effort regulation	Controlling motivation and effort to persist even when faced with difficulties, distractions, or uninteresting tasks (Pintrich et al., 1991, 1993)	
	Help seeking	Seeking assistance from instructors, peers, or other resources when needed (Pintrich et al., 1991, 1993)	
	Peer learning	Communicating and collaborating with peers (e.g., in a study group; Pintrich et al., 1991, 1993)	
	Other	Other measures of resource management strategies (e.g., self-management, practical application; Agonács et al., 2020; Warr et al., 1999)	
Factors associated with SRL strategies	**Learning process-related factors**		.72
	Achievement motivation	An individual's desire to perform well on a task for which standards of excellence exist (Brunstein & Heckhausen, 2018); product of individuals' expectancy of how well they will perform the task and the value they attribute to the task (Eccles, 1983; Eccles & Wigfield, 2020, 2023; Wigfield, 1994; Wigfield & Eccles, 2000)	
	Learning performance	Knowledge, skills, and competences acquired through educational activities (e.g., grades, test scores, self-reported competences; Chaker & Impedovo, 2021; Wan et al., 2012)	
	Learner engagement	Learners' cognitive, behavioral, and affective involvement in learning activities (Halverson & Graham, 2019; Kizilcec et al., 2017; Schunk & Mullen, 2012)	
	Learner satisfaction	Positive affects and perceived contentment related to participation in CE; learners who are satisfied with a CE activity would recommend the activity to friends and engage in a similar activity again (Martin & Bolliger, 2022; Wan et al., 2012; Wu, Hsieh, & Lu, 2015)	
	Completion of the CE activity	Completion of the CE activity (vs. dropout; Moreno-Marcos et al., 2020)	
	Lack of time available for learning	Limitation of the time the learner can spend on the CE activity due to professional and family commitments (Hemmler & Ifenthaler, 2022; Milligan & Littlejohn, 2016)	
	Avoidance behavior	Motivation to avoid negative outcomes as well as motivation to avoid work and effort (Elliot, Gable, & Mapes, 2006; Spinath, Steinsmeier-Pelster, Schöne, & Dickhäuser, 2012)	
	Individual goal achievement	Achievement of individually set learning goals (Kizilcec et al., 2017)	
	Learner-related factors		
	Age	Learner's age	
	Educational level	Learner's educational level	
	Gender	Learner's gender	
	Prior knowledge	Proficiency in and prior experiences with the topic of the CE activity (Peters-Burton & Botov, 2017; Winne, 1996)	

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Table 1 (*continued*)

Variable	Codes	Description	Krippendorff's alpha
	CE experience	Learner's previous participation in CE activities (e.g., number of previous CE activities completed; Alturkistani et al., 2020)	
	Culture	Learner's cultural dimension (Hofstede, 1984; K. Li, 2019)	
	Digital literacy	Knowledge, skills, and competences required to interact in online learning environments (Tinmaz, Lee, Fanea-Ivanovici, & Baber, 2022)	
	General self-regulation	Learner's general tendency towards self-regulation and self-directedness beyond learning (Kyndt et al., 2014; Grant, Franklin, & Langford, 2002)	
	Big five personality traits	Extraversion, agreeableness, neuroticism, openness, conscientiousness (McCrae & Costa, 2004)	
	Curiosity	Tendency to seek and embrace new information and experiences (Kashdan, Disabato, Goodman, & McKnight, 2020)	
	Occupation	Learner's current occupation	
	General attitudes towards learning	Learner's general attitudes and beliefs regarding learning and CE (Schulz & Roßnagel, 2010)	
	Organizational citizenship behavior	Individual behavior that is not directly recognized by a work organization's formal reward system, but that promotes the organization's functionality (Organ, 1988; Podsakoff, MacKenzie, Paine, & Bachrach, 2000)	
	CE-related factors		
	Peer interaction	Instructional design elements that enable interactions between learners (e.g., discussion forums, group work; Janakiraman et al., 2018)	
	Difficulty	(Perceived) difficulty of the CE activity; degree to which the CE activity is perceived as challenging (Rigolizzo & Zhu, 2021)	
	SRL intervention	Specific interventions (e.g., video instructions, dashboards) designed to support SRL (Hosseini et al., 2020; Jansen et al., 2020; J. Wong et al., 2019)	
	Learning content	Characteristics of the learning materials (e.g., topic, content format; Vanslambrouck, Zhu, Pynoo, Thomas et al., 2019)	
	Feedback	Opportunities to receive external feedback on learning progress (Rigolizzo & Zhu, 2021)	
	Self-assessments	Opportunities for self-assessments (e.g., tests, quizzes, problem sets; Janakiraman et al., 2018)	
	Online setting	CE activities delivered online (vs. face-to-face CE activities)	
	Flipped classroom	Type of blended learning in which new instructional contents are introduced before class time as a homework activity; during class time, these contents are discussed in more depth, and learning activities traditionally constituting homework are moved into the classroom (Akçayır & Akçayır, 2018; Hosseini et al., 2020)	
	Organization and structure	Quality of the CE activity in terms of transparency, organization, and structure (Kim et al., 2021)	
	Transactional distance	Barriers to learners' active engagement with learning including barriers to learner–learner interaction, learner–instructor interaction, and learner–content interaction (Kim et al., 2021; Paul, Swart, Zhang, & MacLeod, 2015)	
	Ease of use	Degree to which the learning system is easy to use (Marangunić & Granić, 2015)	
	Duration	Length of the CE activity (e.g., number of learning activities; Janakiraman et al., 2018)	
	Work-related factors		
	Organizational learning culture	Degree to which CE is integrated into the organizational culture; degree to which employees are supported and encouraged to participate in CE activities (Kittel et al., 2021; Marsick & Watkins, 2003)	
	Job control	Learners' potential control over their work tasks and behavior; includes decision authority and possibilities to make use of one's own knowledge, skills, and competences to accomplish the work tasks (Gijbels, Raemdonck, Vervecken, Van Herck, 2012; Karasek, 1979)	
	Job demands	Stressors within the work environment (e.g., stressors related to work tasks, personal conflicts; Gijbels et al., 2012; Karasek, 1979)	
	Working area	Learners' working area (e.g., chemistry, crowdwork; Kreber, Castleden, Erfani, & Wright, 2005; Margaryan, 2019)	
	Team size	Number of team members in the learner's work team	
	Job involvement	Degree to which learners psychologically identify with their job; degree to which learners value the importance of their job (Decius et al., 2021; Griffin, Hogan, Lambert, Tucker-Gail, & Baker, 2010)	
	Task identity	Degree to which the learners' job has a visible outcome in form of a whole product (Hackman & Oldham, 1975; Kittel et al., 2021)	
	Pay satisfaction	Learners' satisfaction with their salary (Kyndt, 2014)	
	Internal employability	Learners' willingness and ability to stay employed within their current organization (Juhdi, Pa'Wan, Othman, & Moksin, 2010; Kyndt, 2014)	
	Friendship relationships with coworkers	Number of friends at work (Geller & Bamberger, 2012)	
	Hours of work	Learners' working hours (e.g., full time vs. part time; van Daal et al., 2014)	

(*continued on next page*)

Table 1 (*continued*)

Variable	Codes	Description	Krippendorff's alpha
Method	Quantitative	The relationship between learners' use of SRL strategies and the associated factor was investigated using quantitative methods	1.0
	Qualitative	The relationship between learners' use of SRL strategies and the associated factor was investigated using qualitative methods	
Sample size	Exact sample size	Exact sample size from study if reported	.86
	N/A	No information on sample size available	
Effect size	Exact effect size	Exact effect size from study if reported	.96
	N/A	No information on effect size available	
Moderators [a]			
Operationalization of SRL strategies	Subjective	Self-report measures	.94
	Objective	Behavioral measures	
Operationalization of associated factors	Subjective	Self-report measures	.97
	Objective	Behavioral measures	
Setting	Online	The CE activity took place exclusively online	.94
	Face-to-face	The CE activity included face-to-face sessions	
Work-relatedness	Work-related	CE activity was linked to learners' job position (Kyndt & Baert, 2013; Schiersmann, 2007)	.88
	Non-work-related	CE activity was not linked to learners' job position (Demary et al., 2013; Schiersmann, 2007)	
Formality [b]	Formal/non-formal	Organized CE activity (Misko, 2008; Radcliffe & Colletta, 1989; Schumacher, 2018)	.76
	Informal	Unorganized CE activity occurring through experiences in daily (work) life (Eraut, 2004; Schiersmann, 2007; Schumacher, 2018)	
	N/A	No information on formality available	

Note. SRL = self-regulated learning; CE = continuing education.

[a] Moderators were coded only for studies included in the moderator analyses. Operationalization of SRL strategies and associated factors were coded at effect size level (i.e., values on these moderator variables can differ for different effect sizes within one study). All other moderators were coded at study level (i.e., values on these moderator variables are identical for all effect sizes within one study).

[b] Most studies did not provide sufficient information to differentiate whether the learning activity was formal or non-formal. Therefore, we differentiated between organized (i.e., formal/non-formal) and informal learning activities.

have suggested that further learning-process related factors, such as learner engagement (Kizilcec et al., 2017), learner satisfaction (Lee et al., 2020a), or completion of the CE activity (Handoko et al., 2019) might be associated with SRL strategies in CE.

4.2. Learner-related factors

Learner-related factors describe learners' general dispositions and beliefs in relation to CE (Greene & Azevedo, 2007; Winne, 2022). SRL researchers have suggested that different learners exposed to the same learning context might engage in SRL differently due to individual differences (Greene & Azevedo, 2007; Winne, 1996). In a systematic review focusing on MOOCs and online higher education, J. Wong et al. (2019) showed that learners' cognitive ability, gender, and prior knowledge influenced the effectiveness of SRL interventions. Another systematic review identified several learner-related factors (e.g., goal-setting and reflective skills, previous experiences) associated with medical students' and residents' use of SRL strategies (van Houten-Schat et al., 2018). However, systematic reviews and meta-analyses investigating learner-related factors with a broader focus on CE are missing. Empirical primary studies have suggested that further learner-related factors, such as age (Haemer et al., 2017) and personality traits (van Daal, Donche, & De Maeyer, 2014), might be associated with SRL strategies in CE.

4.3. Continuing education-related factors

CE-related factors refer to instructional characteristics and learners' perceptions of the CE activity (Alonso-Mencía et al., 2020; Hemmler & Ifenthaler, 2022). According to Pintrich (2000), SRL is guided and constrained by contextual characteristics of the learning activity (e.g., learning tasks, classroom climate). Such characteristics may influence how learners operate on learning materials and what SRL strategies they apply (Winne, 2011, 2022; Winne & Hadwin, 1998). In their systematic review focusing on MOOCs, Alonso-Mencía et al. (2020) revealed that the need for SRL strategies increased with the length of the MOOC and that learners' use of SRL strategies may be influenced by course design and delivery mode. Further systematic reviews summarized interventions (e.g., prompts, feedback) designed to trigger SRL strategies in MOOCs and online higher education (e.g., J. Wong et al., 2019). These CE-related factors identified in previous systematic reviews on MOOCs need to be complemented by a broader view on CE, as empirical primary studies have revealed further CE-related factors (e.g., peer interaction) associated with SRL strategies in CE (e.g., Vanslambrouck, Zhu, Pynoo, Thomas, et al., 2019).

4.4. Work-related factors

Work-related factors describe job characteristics and learners' perceptions of their work environment (Hemmler & Ifenthaler, 2022). As CE may be directly linked to learners' job position (Demary et al., 2013; Schiersmann, 2007), researchers have suggested that work-related factors may influence SRL (Gijbels, Raemdonck, Vervecken, & Van Herck, 2012; Kittel et al., 2021). For example, job control and job demands have been associated with SRL strategies in empirical primary studies (e.g., Gijbels et al., 2012; Raemdonck et al., 2014). However, a comprehensive list of work-related factors triggering or inhibiting SRL strategies in CE is missing.

4.5. Potential moderators

Researchers have argued that methodological features (e.g., operationalization of variables) might impact SRL (Hadwin, Nesbit, Jamieson-Noel, Code, & Winne, 2007; Winne & Hadwin, 1998) and that the relevance of specific SRL strategies might differ for different types of learning activities (e.g., online vs. face-to-face, formal vs. informal learning activities; Beishuizen & Steffens, 2011; Broadbent & Poon, 2015). However, research investigating how methodological features and the type of the CE activity moderate the relationships between SRL strategies and learning process-related, learner-related, CE-related, and work-related factors is lacking. Therefore, we employed the following variables as potential moderators.

4.5.1. Operationalization of variables

In empirical studies, SRL strategies can be measured subjectively using self-report questionnaires (e.g., Barnard, Lan, To, Paton, & Lai, 2009; Pintrich et al., 1991) or objectively using behavioral measures, such as trace data in online learning environments (Araka, Maina, Gitonga, & Oboko, 2020; Winne, 2022). Moreover, several learning process-related, learner-related, CE-related, and work-related factors can be measured subjectively (e.g., self-reported learning performance; Schulz & Roßnagel, 2010) or objectively (e.g., learning performance measured by knowledge tests; Tang, 2021). Learners' subjective experiences may differ from objective measures, and, therefore, the operationalization of variables might affect the relationships between SRL strategies and learning process-related, learner-related, CE-related, as well as work-related factors (Aeon & Aguinis, 2017; Hadwin et al., 2007; Tempelaar, Rienties, & Nguyen, 2020).

4.5.2. Setting

Online CE provides high degrees of autonomy and flexibility to learners. In contrast to traditional (classroom-based) face-to-face learning activities, where all learners learn at the same place and time, online CE is often self-paced (Broadbent & Poon, 2015; Fan, Matcha, Uzir, Wang, & Gašević, 2021). Consequently, the need for SRL strategies might be higher in online than in face-to-face CE activities (Broadbent & Poon, 2015; Nawrot & Doucet, 2014). Thus, the setting of the CE activity might moderate the relationships between SRL strategies and potential antecedents and outcomes.

4.5.3. Work-relatedness

In contrast to non-work-related CE, work-related CE may be mandatory and externally regulated by the employer. If the employer decides what and when should be learned, learners may have fewer possibilities to self-regulate their learning (Hemmler et al., 2023). Thus, work-relatedness of the CE activity might have an impact on learners' need for SRL strategies and the strength of the relationships between learners' use of SRL strategies and potential antecedents and outcomes.

4.5.4. Formality

Since informal learning activities are not organized by external entities (Eraut, 2004; Schumacher, 2018), they might require a stronger need for SRL strategies than non-formal and formal learning activities (Beishuizen & Steffens, 2011). Thus, the formality of the CE activity might affect the relationships between SRL strategies and learning process-related, learner-related, CE-related, as well as work-related factors.

5. Research questions

Based on the research discussed above, we formulated the following research questions.

1. What learning process-related, learner-related, CE-related, and work-related factors have been associated with learners' use of SRL strategies in empirical studies focusing on CE?
2. To what extent are these factors related to learners' use of SRL strategies in CE?
3. To what extent do methodological features (i.e., operationalization of variables) and the type of the CE activity (i.e., setting, work-relatedness, formality) moderate these relationships?

6. Method

6.1. Search strategies

We developed a research protocol describing search strategies, inclusion criteria, and definitions of key terms. All members of the

research team were familiarized with the research protocol in a training session conducted by the first author of this paper. To identify empirical studies that investigated SRL strategies in CE, several search strategies were performed by the first author of this paper and one trained research assistant. First, we conducted an electronic search in the databases Educational Resources Information Center (via ProQuest), psycArticles, psycINFO, and PSYNDEX (via EBSCOhost) using the search string presented in Table 2. The database search was conducted between April 4, 2022, and April 11, 2022. Second, we conducted a manual search of the list of publications included in Sitzmann and Ely's (2011) meta-analysis. Third, we conducted a manual search of the reference lists of a selection of relevant publications that were identified through the database search. To be precise, the reference lists of the following publications were searched: Agonács et al. (2020), Birenbaum and Rosenau (2006), Chen and Jang (2019), and Lourenco and Ferreira (2019). The search strategies yielded a total number of 13,465 publications.

6.2. Publication screening

Fig. 1 presents an overview of the publication screening process. First, duplicates and publications not published in an academic journal were removed by the first author of this paper through an automatic search in Microsoft Excel. Then, titles, abstracts, and full texts of the remaining publications were screened for the inclusion and exclusion criteria presented in Table 3. Titles, abstracts, and full texts were divided among and screened by the first author of this paper and one trained research assistant. Fifty-seven publications containing $m = 58$ studies were identified as eligible for our systematic review and meta-analysis. The total sample size of all included studies was $N = 48{,}213$ learners.

6.3. Coding procedures

All factors associated with SRL strategies in CE were inductively extracted from the primary studies and assigned to one of the following four main categories: learning process-related, learner-related, CE-related, or work-related factors. Further information on the relationships between these factors and the associated SRL strategies was coded (e.g., method, effect size; see Table 1). The first author of this paper initially coded all studies and developed a coding manual. Then, a research assistant who was given 2 h of additional training independently coded all studies for verification. An overview of the coding manual and intercoder reliability is shown in Table 1. Differences between coders were resolved by discussion.

6.4. Meta-analytics procedures

Meta-analyses were conducted to answer research questions 2 and 3. Zero-order correlations r were used as common effect size measure. If zero-order correlations were not reported, they were calculated from available descriptive statistics or converted from other effect sizes. Authors of the studies were contacted if studies did not provide sufficient information to compute zero-order correlations. If the authors did not respond or could not provide the information required, these studies were excluded from the meta-analyses. Following the approach of Tayfur, Prior, Roy, Fitzpatrick, and Forsyth (2021), we conducted meta-analyses for each learning process-related, learner-related, CE-related, and work-related factor for which zero-order correlations with SRL strategies were available from at least three studies. Consequently, meta-analyses for the relationships between SRL strategies and the following 13 factors were conducted: achievement motivation, learning performance, learner engagement, learner satisfaction, avoidance behavior, age, educational level, prior knowledge, job tenure, CE experience, organizational learning culture, job control, and job demands.

6.4.1. Three-level meta-analytic models

Since some studies reported several effect sizes for one relationship, independency of effect sizes was not given. To deal with the dependency of effect sizes, we followed the guidelines proposed by Assink and Wibbelink (2016) and deployed random-effects three-level meta-analytic models that included three variance components: sampling variance (level 1), within-study variance (level 2), and between-study variance (level 3). We used the metafor package (Viechtbauer, 2010) for R (version 4.3.0) to implement

Table 2
Search string for search in databases.

Topic	Search terms
SRL	("self-regulated learning" OR "self-regulation" OR "self- directed learning" OR "learning strateg*" OR "cognitive strateg*" OR "metacognit*" OR "resource management strateg*" OR "resource strateg*" OR "time and study environment" OR "time management" OR "environm* structuring" OR "effort regulation" OR "peer learning" OR "help seeking" OR "goal setting" OR "self-evaluation" OR "self-reflection" OR "self-control" OR "self-observation" OR "self-management" OR "self-monitoring" OR "task strateg*")
AND	
CE	("continuing education" OR "further education" OR "workplace learning" OR "work-related learning" OR "work-based learning" OR "employee learning" OR "employee training" OR "employee development" OR "professional development" OR "professional training" OR "vocational education" OR "vocational training" OR "VET" OR "lifelong learning" OR "lifelong education" OR "continuous learning" OR "adult education" OR "Massive Open Online Course*" OR "MOOC*" OR "on-the-job training" OR "off-the-job training" OR "near-the-job training" OR "operational training" OR "corporate training")

Note. We did not restrict the database search to a specific part of a publication (i.e., the combinations of search terms could appear anywhere in a document). SRL = self-regulated learning; CE = continuing education.

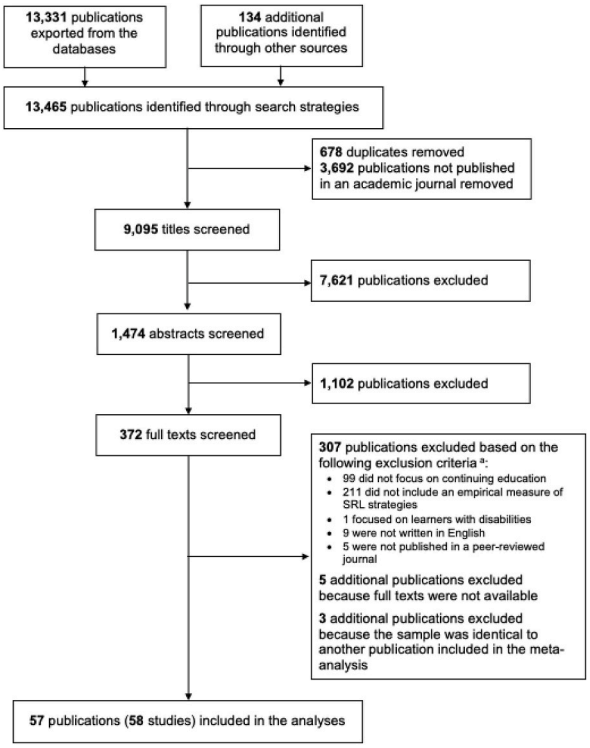

Fig. 1. Flow diagram of the publication screening process.
Note. SRL = self-regulated learning.
a Some publications were excluded for multiple reasons. Therefore, the sum of publications across all exclusion criteria is greater than 307.

Table 3
Inclusion and exclusion criteria.

Inclusion criterion	Exclusion criterion	Justification/Explanation
The study focused on CE.	The study did not focus on CE but on a different educational context (e.g., K- 12 or higher education).	CE is the primary focus of our systematic review and meta-analysis. For studies in which only part of the sample focused on CE and the other part focused on another educational context, only the sample focusing on CE was included.
The study reported an empirical measure (quantitative and/or qualitative) of SRL strategies.	The study did not include an empirical measure of SRL strategies.	Information on SRL strategies was needed to answer our research questions. Interventions to support SRL strategies were not considered as a measure of SRL strategies, as these interventions might have influenced other constructs and may not adequately represent SRL (Davis, Chen, Jivet, Hauff, & Houben, 2016; J. Wong et al., 2021).
The study investigated SRL strategies in relation to other variables.	The study focused exclusively on SRL strategies.	Information on variables associated with SRL strategies was needed to answer our research questions.
The study focused on learners without disabilities.	The study focused on learners with disabilities.	Learners with disabilities may have different approaches to SRL than leaners without disabilities (Klassen, 2010).
The study was written in English.	The study was not written in English.	Restriction based on language were necessary because of the language proficiency of the research team. We decided to focus on studies published in English as the international language of science (Drubin & Kellogg, 2012).
The study was published in a peer-reviewed journal.	The study was not published in a peer-reviewed journal.	The quality of a meta-analysis depends on the quality of the included primary studies (Egger et al., 2001). To guarantee a minimum level of quality of primary studies, we decided to exclude studies not published in a peer-reviewed journal.

Note. SRL = self-regulated learning; CE = continuing education.

our three-level meta-analytic models. As recommended by Assink and Wibbelink (2016), the models were fitted using restricted maximum-likelihood estimation, and a *t*-distribution was used to compute *p*-values and confidence intervals of the average correlations. Significance levels were set at .05. As recommended by Borenstein, Hedges, Higgins, and Rothstein (2009), zero-order correlations *r* were transformed into Fisher's *z* for analyses. Due to distribution characteristics, correlations *r* might introduce bias when the

standard error for studies with small sample sizes is estimated (Alexander, Scozzaro, & Borodkin, 1989; Harrer, Cuijpers, Furukawa, & Ebert, 2021). For interpretation of the meta-analytic results, Fisher's z scores were back-transformed into r and interpreted using Cohen's (1988) classification.

For each of the 13 factors (i.e., achievement motivation, learning performance, etc.), we conducted meta-analyses including all measures of SRL strategies provided in the primary studies (in the following referred to as *pooled* meta-analyses). If studies reported different measures of SRL strategies and a composite score summarizing these different measures, only the composite score was included in the pooled meta-analyses to avoid double counting effect sizes. In the next step, we tested whether the average correlations differed for different measures of SRL strategies. We conducted additional meta-analyses for measures of cognitive, metacognitive, resource management, and composite scores of SRL strategies as well as for each of the specific SRL strategies presented in Table 1. To ensure meaningful analyses, the meta-analyses for the different SRL strategies, as well as the subsequent moderator analyses, were conducted only for factors for which zero-order correlations r with cognitive, metacognitive, resource management, and composite scores of SRL strategies were available from at least three studies. Consequently, meta-analyses for different SRL strategies and moderator analyses were conducted for achievement motivation, learning performance, learner engagement, learner satisfaction, and organizational learning culture.

6.4.2. *Measures of heterogeneity and publication bias*

We addressed heterogeneity in effect sizes using the Q-test and the I^2 statistic. In three-level meta-analytic models, two values of I^2 need to be considered because the heterogeneity variance is composed of two parts: the proportion of variance attributable to level 2 (within-study variance, represented by I^2_{within}) and the proportion of variance attributable to level 3 (between-study variance, represented by I^2_{between}; Assink & Wibbelink, 2016). Pooled meta-analyses were tested for publication bias using funnel plots and a three-level version of the Egger's regression test (Fernández-Castilla et al., 2021; Rodgers & Pustejovsky, 2021). Original Egger's regression test (Egger, George, Schneider, & Minder, 1997) has been developed for two-level meta-analyses assuming independency of effect sizes. Research has shown that ignoring dependency of effect sizes when employing Egger's regression test may lead to inflated Type I error rates (Rodgers & Pustejovsky, 2021). Therefore, we deployed a three-level version of the Egger's regression test whereby the estimated standard error of Fisher's z was added as an independent variable in a three-level meta-regression, including between-study and within-study variance. A significant regression coefficient for the standard error $b_{\text{SE\_z}}$ indicated funnel plot asymmetry (Fernández-Castilla et al., 2021; Rodgers & Pustejovsky, 2021).

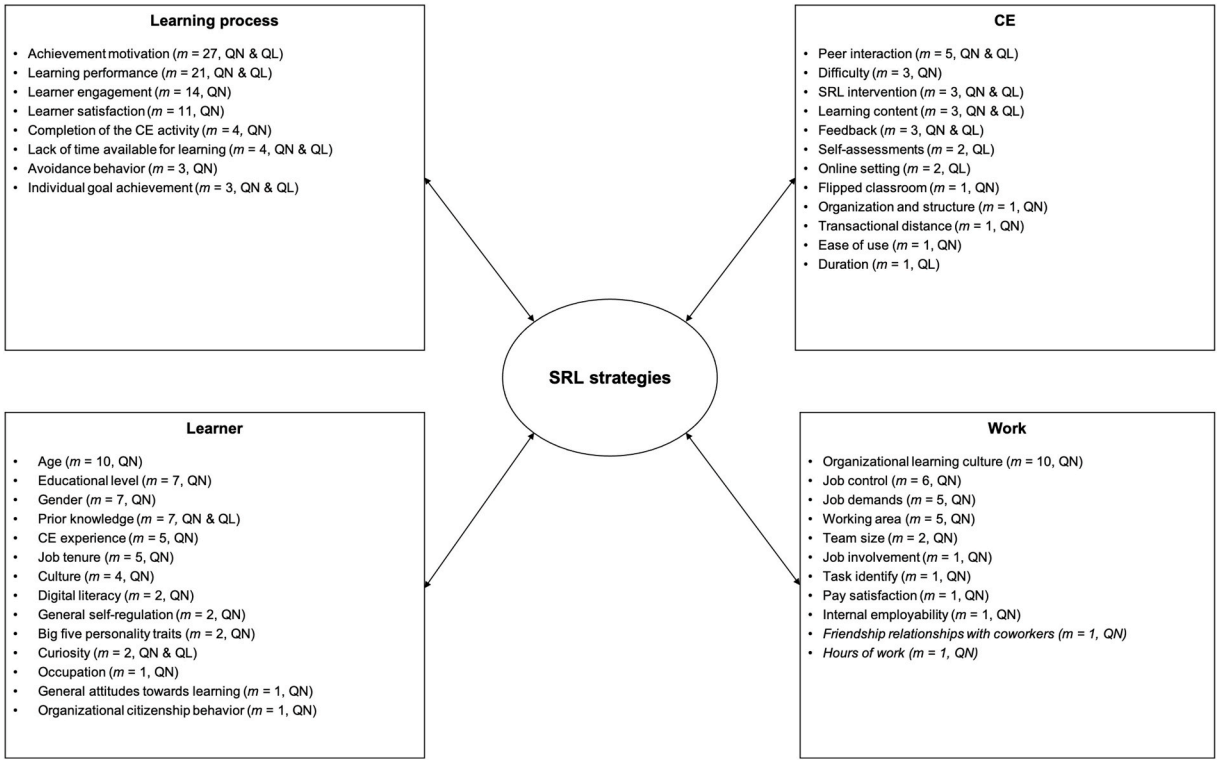

Fig. 2. Factors associated with SRL strategies in CE

Note. All factors investigated using quantitative methods were significant in at least one study except for friendship relationships with coworkers and hours of work (marked in italics), for which no significant effects were found. SRL = self-regulated learning; CE = continuing education; QN = relationship with SRL strategies was investigated using quantitative methods; QL = relationship with SRL strategies was investigated using qualitative methods.

6.4.3. Moderator analyses

Moderators were tested by adding them as independent variables in a three-level multiple meta-regression. We performed moderator analyses for the pooled meta-analyses as well as the meta-analyses focusing on cognitive, metacognitive, resource management, and composite scores of SRL strategies. Moderator analyses were not performed for the specific SRL strategies presented in Table 1 due to limited number of primary studies. We employed multiple meta-regression analyses to test all moderators simultaneously. As such, the unique effect of each moderator can be tested, controlling for the other moderators in the model (Assink & Wibbelink, 2016). To increase the reliability of moderator analyses, moderators were included in the meta-regression only if at least three zero-order correlations *r* were available for each coded category of the moderator (see also moderator analyses conducted by Li, Bi, Willems, & Finkenauer, 2021).

7. Results

7.1. Included studies and publication bias

An overview of all studies included in our investigations is presented in the supplementary materials (see S1 for characteristics of all included studies and S2 for a detailed description of the studies included in the meta-analyses). Funnel plots and the results of the three-level version of the Egger's regression test can be found in the supplementary materials S3 and S4. No statistically significant asymmetry in funnel plots was detected.

7.2. Research question 1: factors associated with self-regulated learning strategies

Fig. 2 provides an overview of all factors associated with learners' use of SRL strategies in the included primary studies.

7.2.1. Learning process-related factors

In several studies, SRL strategies were positively associated with achievement motivation (e.g., Chung, 2015; Lee, Watson, Watson, 2020; Zhu, Bonk, Doo, 2020), learning performance (e.g., Moraes & Borges-Andrade, 2015; Wan et al., 2012), learner engagement (e.g., Fontana et al., 2015; Siadaty et al., 2016), learner satisfaction (e.g., Lourenco & Ferreira, 2019; Tsai et al., 2018), completion of the CE activity (e.g., Guajardo Leal, 2019; Hughes, 2019), and individual goal achievement (e.g., Kizilcec et al., 2017; Kormos & Csizér, 2014), as well as negatively associated with avoidance behavior (e.g., Schulz & Roßnagel, 2010; van Daal et al., 2014). Lack of time available for learning was identified as a barrier to learners' use of cognitive (Hosseini et al., 2020; Rabin et al., 2020), metacognitive (Hosseini et al., 2020; Milligan & Littlejohn, 2016; Rabin et al., 2020), and peer learning (Milligan & Littlejohn, 2016) strategies. Consequently, effective time management was identified as a prerequisite for other SRL strategies (Milligan & Littlejohn, 2016). Time management strategies were considered especially important for learners with professional and family commitments (e.g., child care) limiting learners' time available for learning (Vanslambrouck, Zhu, Pynoo, Thomas, et al., 2019).

7.2.2. Learner-related factors

The studies that examined learner-related factors mainly sought to identify relationships between SRL strategies and demographic variables (e.g., age, educational level; Alonso-Mencía, Alario-Hoyos, Estévez-Ayres, & Kloos, 2021; Martinez-Lopez et al., 2017; Schulz & Roßnagel, 2010) as well as learners' prior knowledge and experiences (e.g., job tenure, CE experience; Haemer et al., 2017; Warr & Bunce, 1995). The findings of these studies varied regarding the strength and direction of the relationships. Moreover, some studies identified positive relationships between SRL strategies and personality traits (e.g., curiosity; Decius et al., 2021) as well as general attitudes towards learning (Schulz & Roßnagel, 2010).

7.2.3. Continuing education-related factors

Several instructional methods such as peer interaction (Haemer et al., 2017), feedback (Kittel et al., 2021), self-assessments (Janakiraman et al., 2018), and flipped classroom (Hosseini et al., 2020) were positively associated with SRL strategies in the included primary studies. SRL strategies were considered more important the longer the duration of the CE activity (Janakiraman et al., 2018) and for CE activities delivered online than for face-to-face CE activities (Milligan & Littlejohn, 2016; Vanslambrouck, Zhu, Pynoo, Thomas, et al., 2019). Some studies (e.g., Jansen et al., 2020; J. Wong et al., 2021) investigated interventions for supporting SRL strategies in online learning environments. However, the impact of these interventions on SRL strategies was limited (Jansen et al., 2020; J. Wong et al., 2021). Vanslambrouck, Zhu, Pynoo, Thomas, et al. (2019) revealed that learning contents (e.g., content format) might influence learners' choice of cognitive strategies. Further, SRL strategies were positively associated with perceived difficulty (e.g., Rigolizzo & Zhu, 2021; Warr et al., 1999), organization and structure (Kim et al., 2021), transactional distance (Kim et al., 2021), and ease of use (Lin, Liang, Tsai, & Hu, 2018) of the CE activity.

7.2.4. Work-related factors

An organizational learning culture supporting learners' engagement in CE activities (e.g., Decius et al., 2021; Kittel et al., 2021) as well as job control (e.g., Gijbels et al., 2012; Straka, 2000), job demands (e.g., Raemdonck et al., 2014; Wan et al., 2012), team size (Geller & Bamberger, 2012), job involvement (Decius et al., 2021), task identity (Kittel et al., 2021), pay satisfaction (Kyndt et al., 2014), and internal employability (Kyndt et al., 2014) were positively associated with SRL strategies in the included primary studies. Weak and partially nonsignificant relationships between SRL strategies and working area (e.g., Haemer et al., 2017; Margaryan, 2019),

hours of work (van Daal et al., 2014), and friendship relationships with coworkers (Geller & Bamberger, 2012) were identified.

7.3. Research question 2: strength of the relationships

7.3.1. Pooled meta-analyses

The results of the pooled meta-analyses are presented in Table 4. Significant relationships between SRL strategies and all learning process-related variables included in the pooled meta-analyses were detected. The average correlation coefficient indicated a weak negative relationship for avoidance behavior ($r = -.14$), moderate positive relationships for achievement motivation ($r = .30$) and learner satisfaction ($r = .30$), as well as moderate to strong positive relationships for learning performance ($r = .36$) and learner engagement ($r = .39$). No significant relationships between SRL strategies and the learner-related variables age, educational level, and job tenure were detected. The average correlations for prior knowledge ($r = .05$) and CE experience ($r = .08$) were significant but weak. Significant positive relationships between SRL strategies and all work-related variables included in the pooled meta-analyses were detected. The average correlation coefficients indicated a weak to moderate relationship for job demands ($r = .21$) and moderate relationships for organizational learning culture ($r = .26$) and job control ($r = .28$).

7.3.2. Analyses for different SRL strategies

Tables 5–9 show the meta-analytic results for the relationships between different SRL strategies and achievement motivation (Table 5), learning performance (Table 6), learner engagement (Table 7), learner satisfaction (Table 8), and organizational learning culture (Table 9). Average correlation coefficients for achievement motivation indicated a weak to moderate relationship with resource management strategies ($r = .24$), moderate relationships with cognitive ($r = .28$) and metacognitive ($r = .30$) strategies, as well as a moderate to strong relationship with composite scores of SRL strategies ($r = .39$). Average correlation coefficients for learning performance showed a weak to moderate relationship with cognitive strategies ($r = .16$), a moderate relationship with resource management strategies ($r = .29$), a moderate to strong relationship with metacognitive strategies ($r = .44$), and a strong relationship with composite scores of SRL strategies ($r = .48$). For learner engagement, average correlation coefficients indicated a moderate relationship with cognitive strategies ($r = .30$), a moderate to strong relationship with metacognitive strategies ($r = .35$), and a strong relationship with composite scores of SRL strategies ($r = .46$). The relationship between resource management strategies and learner engagement was not significant. For learner satisfaction, average correlation coefficients indicated a weak to moderate relationship with resource management strategies ($r = .20$) as well as moderate relationships with cognitive ($r = .26$), metacognitive ($r = .33$), and composite scores of SRL ($r = .27$) strategies. Regarding organizational learning culture, weak to moderate relationships with cognitive strategies ($r = .15$) and resource management strategies ($r = .23$) as well as moderate relationships with metacognitive ($r = .27$) and composite scores of SRL ($r = .27$) strategies were detected.

Table 4
Results for the pooled meta-analyses: Relationships between SRL strategies and associated factors.

Associated Factor	*K*	*m*	*n*	*r*	95% CI for *r*		Heterogeneity		
					LL	UL	*Q*(*df*)	I^2_{within}	$I^2_{between}$
Learning process-related factors									
Achievement motivation	195	24	7267	.30***	.24	.35	1567.15(194)***	46.86	42.27
Learning performance	61	15	13,745	.36***	.23	.47	1874.50(60)***	30.10	67.33
Learner engagement	79	12	9504	.39***	.25	.51	1768.89 (78)***	11.11	86.93
Learner satisfaction	29	7	1133	.30***	.17	.41	88.67(28)***	7.35	65.65
Avoidance behavior	6	3	675	−.14**	−.22	−.06	9.79(5)†	50.86	0.00
Learner-related factors									
Age	22	8	19,190	.00	−.09	.09	185.07(21)***	18.99	77.68
Educational level	19	6	18,598	.03†	−.00	.06	64.09(18)***	83.88	0.00
Prior knowledge	14	5	17,595	.05**	.02	.07	76.59(13)***	81.95	0.00
Job tenure	13	5	1887	−.01	−.16	.14	111.97(12)***	25.88	65.60
CE experience	20	4	18,080	.08*	.00	.16	292.04(19)***	24.16	71.50
Work-related factors									
Organizational learning culture	39	10	4189	.26***	.17	.34	247.70(38)***	12.94	71.17
Job control	13	5	1433	.28***	.23	.33	10.07(12)	0.00	15.43
Job demands	7	5	2006	.21*	.01	.40	84.62(6)***	0.00	90.61

Note. Meta-analyses were not conducted for gender and working area, although effect sizes were reported in at least three studies, because these factors were categorical in all included primary studies and not sufficient information to calculate the standard error of the standardized mean differences was available. Moreover, working area was operationalized too differently across studies to meaningfully summarize effect sizes in a meta-analysis. *k* = number of effect sizes; *m* = number of primary studies; *n* = total sample size; *r* = average correlation; CI = confidence interval; LL = lower limit; UL = upper limit.
†$p < .10$.
*$p < .05$.
**$p < .01$.
***$p < .001$.

Table 5
Achievement motivation: Results for different SRL strategies.

SRL strategies	*k*	*m*	*N*	*R*	95% CI of *r*		Heterogeneity		
					LL	UL	*Q*(*df*)	I^2_{within}	$I^2_{between}$
Cognitive strategies	**46**	**13**	**3594**	**.28*****	**.19**	**.36**	**471.85(45)*****	**39.10**	**50.40**
Rehearsal [a]	2	2	621	.28	−1.0	1.0	33.99(1)***	–	97.06
Elaboration	8	5	1472	.35*	.07	.58	148.59(7)***	4.21	91.19
Organization [a]	2	2	621	.35	−.95	.99	14.89(1)***	–	93.29
Critical thinking	4	3	791	.39**	.22	.54	6.60(3)†	0.00	60.88
Other	30	8	2122	.27***	.17	.36	213.97(29)***	41.39	45.16
Metacognitive strategies	**85**	**15**	**3604**	**.30*****	**.22**	**.37**	**559.89(84)*****	**37.33**	**50.16**
Goal setting and planning	23	8	2094	.30***	.20	.40	156.31(22)***	46.07	41.71
Self-monitoring	6	2	578	.36**	.23	.48	16.13(5)**	69.25	0.00
Self-evaluation and reaction	32	9	2499	.27***	.13	.39	264.22(31)***	14.60	75.91
Self-satisfaction	4	2	532	.40***	.31	.48	2.13(3)	0.00	0.00
Metacognitive self-regulation	20	8	1715	.34***	.29	.40	74.66(19)***	76.75	0.00
Resource management strategies	**81**	**14**	**4478**	**.24*****	**.17**	**.30**	**572.81(80)*****	**56.23**	**31.18**
Time and study environment	19	7	3102	.27***	.19	.34	112.92(18)***	82.22	4.88
Effort regulation	17	7	2896	.23*	.01	.43	268.35(16)***	4.75	89.46
Help seeking	19	7	2172	.20**	.08	.31	94.09(18)***	12.70	71.61
Peer learning [a]	2	2	621	.29	−.82	.94	6.58(1)*	–	84.79
Other	24	5	843	.26***	.19	.33	57.94(23)***	43.59	22.36
Composite score	**21**	**11**	**2958**	**.39*****	**.29**	**.48**	**271.30(20)*****	**52.28**	**37.90**

Note. SRL = self-regulated learning; *k* = number of effect sizes; *m* = number of primary studies; *n* = total sample size; *r* = average correlation; CI = confidence interval; LL = lower limit; UL = upper limit.
†$p < .10$.
*$p < .05$.
**$p < .01$.
***$p < .001$.
[a] Traditional two-level meta-analysis (variance components: sampling variance and variance between studies) was performed because only one effect size was reported per study (restricted maximum-likelihood estimation and the Knapp and Hartung, 2003 method were used to compute the models).

Table 6
Learning performance: Results for different SRL strategies.

SRL strategies	*k*	*m*	*n*	*R*	95% CI of *r*		Heterogeneity		
					LL	UL	*Q*(*df*)	I^2_{within}	$I^2_{between}$
Cognitive strategies	**19**	**7**	**2183**	**.16****	**.07**	**.25**	**215.82(18)*****	**84.19**	**5.88**
Rehearsal	5	2	1216	.10	−.24	.41	47.66(4)***	29.83	64.01
Elaboration	–	–	–	–	–	–	–	–	–
Organization	–	–	–	–	–	–	–	–	–
Critical thinking	–	–	–	–	–	–	–	–	–
Other	13	6	2092	.20**	.08	.31	149.48(12)***	82.74	6.58
Metacognitive strategies	**18**	**6**	**2024**	**.44*****	**.26**	**.59**	**374.49(17)*****	**21.94**	**72.59**
Goal setting and planning [a]	4	4	808	.45†	−.03	.76	67.68(3)***	–	95.54
Self-monitoring [a]	2	2	523	.49	−.99	1.0	27.54(1)***	–	96.37
Self-evaluation and reaction	11	6	2024	.43***	. 31	.53	152.94(10)***	90.55	0.00
Self-satisfaction	–	–	–	–	–	–	–	–	–
Metacognitive self-regulation	–	–	–	–	–	–	–	–	–
Resource management strategies	**31**	**9**	**11,161**	**.29****	**.10**	**.47**	**559.84(30)*****	**22.62**	**74.92**
Time and study environment	4	2	394	.49	−.40	.90	103.53(3)***	51.30	46.48
Effort regulation	4	2	357	.46	−.89	.98	194.54(3)***	0.09	99.03
Help seeking	15	5	10,449	.19*	.03	.35	183.46(14)***	25.87	69.67
Peer learning	–	–	–	–	–	–	–	–	–
Other	8	3	481	.21†	−.05	.45	32.81(7)***	1.18	82.66
Composite score	**8**	**5**	**2436**	**.48****	**.28**	**.65**	**160.48(7)*****	**9.90**	**84.91**

Note. Dashes indicate that no meta-analysis was performed due to the limited number of primary studies. SRL = self-regulated learning; *k* = number of effect sizes; *m* = number of primary studies; *n* = total sample size; *r* = average correlation; CI = confidence interval; LL = lower limit. UL = upper limit.
†$p < .10$.
*$p < .05$.
**$p < .01$.
***$p < .001$.
[a] Traditional two-level meta-analysis (variance components: sampling variance and variance between studies) was performed because only one effect size was reported per study (restricted maximum-likelihood estimation and the Knapp and Hartung, 2003 method were used to compute the models)

Table 7
Learner engagement: Results for different SRL strategies.

SRL strategies	*k*	*m*	*n*	*R*	95% CI of *r*		Heterogeneity		
					LL	UL	*Q*(*df*)	I^2_{within}	$I^2_{between}$
Cognitive strategies	**13**	**5**	**5722**	**.30***	**.01**	**.54**	**203.60(12)*****	**2.68**	**95.14**
Rehearsal	–	–	–	–	–	–	–	–	–
Elaboration	4	3	5512	.25	−.16	.59	55.30(3)***	5.63	93.12
Organization	–	–	–	–	–	–	–	–	–
Critical thinking	–	–	–	–	–	–	–	–	–
Other	8	2	210	.37	−.45	.85	88.30(7)***	4.49	90.41
Metacognitive strategies	**48**	**5**	**5545**	**.35***	**.08**	**.57**	**778.39(47)*****	**5.38**	**92.65**
Goal setting and planning	23	3	5048	.39*	.04	.65	355.19(22)***	12.02	86.31
Self-monitoring	–	–	–	–	–	–	–	–	–
Self-evaluation and reaction	21	4	5356	.26	−.06	.54	280.12(20)***	1.55	94.92
Self-satisfaction	–	–	–	–	–	–	–	–	–
Metacognitive self-regulation	3	2	359	.55**	.40	.66	1.25(2)	0.00	0.00
Resource management strategies	**13**	**4**	**6426**	**.20†**	**−.04**	**.41**	**241.40(12)*****	**7.94**	**88.80**
Time and study environment	3	2	1432	.34*	.02	.60	8.37(2)*	82.07	0.00
Effort regulation	4	2	352	.22	−.48	.75	36.72(3)***	0.00	94.60
Help seeking	4	2	4994	.02	−.08	.11	11.80(3)**	70.62	0.00
Peer learning	–	–	–	–	–	–	–	–	–
Other	–	–	–	–	–	–	–	–	–
Composite score	**9**	**6**	**7370**	**.46*****	**.26**	**.62**	**601.81(9)*****	**23.61**	**74.76**

Note. Dashes indicate that no meta-analysis was performed due to the limited number of primary studies. SRL = self-regulated learning; *k* = number of effect sizes; *m* = number of primary studies; *n* = total sample size; *r* = average correlation; CI = confidence interval; LL = lower limit. UL = upper limit.
†$p < .10$.
*$p < .05$.
**$p < .01$.
***$p < .001$.

Table 8
Learner satisfaction: Results for different SRL strategies.

SRL strategies	*k*	*m*	*n*	*R*	95% CI of *r*		Heterogeneity		
					LL	UL	*Q*(*df*)	I^2_{within}	$I^2_{between}$
Cognitive strategies [a]	**3**	**3**	**406**	**.26****	**.18**	**.33**	**0.29(2)**	–	**0.00**
Rehearsal	–	–	–	–	–	–	–	–	–
Elaboration	–	–	–	–	–	–	–	–	–
Organization	–	–	–	–	–	–	–	–	–
Critical thinking	–	–	–	–	–	–	–	–	–
Other [a]	3	3	406	.26**	.18	.33	0.29(2)	–	0.00
Metacognitive strategies	**19**	**4**	**652**	**.33****	**.15**	**.48**	**55.91(18)*****	**0.00**	**74.78**
Goal setting and planning	7	4	652	.27*	.04	.47	25.28(6)***	74.93	0.00
Self-monitoring	5	3	652	.25**	.12	.36	2.59 (4)	0.00	0.00
Self-evaluation and reaction	6	3	652	.27**	.17	.37	5.12(5)	0.00	0.00
Self-satisfaction	–	–	–	–	–	–	–	–	–
Metacognitive self-regulation	–	–	–	–	–	–	–	–	–
Resource management strategies	**24**	**5**	**581**	**.20*****	**.11**	**.29**	**69.51(23)*****	**69.04**	**0.00**
Time and study environment	9	2	312	.19***	.11	.28	5.28(8)	0.00	0.00
Effort regulation	7	3	475	.09	−.13	.30	12.33(6)†	59.30	0.00
Help seeking	5	3	475	.12	−.20	.41	13.12(4)*	73.01	0.00
Peer learning	–	–	–	–	–	–	–	–	–
Other [a]	3	3	481	.39**	.28	.49	0.80(2)	–	0.00
Composite score	**4**	**3**	**524**	**.27****	**.14**	**.39**	**1.67(3)**	**0.00**	**0.00**

Note. Dashes indicate that no meta-analysis was performed due to the limited number of primary studies; SRL = self-regulated learning. *k* = number of effect sizes; *m* = number of primary studies; *n* = total sample size; *r* = average correlation; CI = confidence interval; LL = lower limit. UL = upper limit.
†$p < .10$.
*$p < .05$.
**$p < .01$.
***$p < .001$.
[a] Traditional two-level meta-analysis (variance components: sampling variance and variance between studies) was performed because only one effect size was reported per study (restricted maximum-likelihood estimation and the Knapp and Hartung, 2003 method were used to compute the models).

Table 9
Organizational learning culture: Results for different SRL strategies.

SRL strategies	*k*	*m*	*N*	*R*	95% CI of *r*		Heterogeneity		
					LL	UL	*Q*(*df*)	I^2_{within}	$I^2_{between}$
Cognitive strategies	**9**	**4**	**940**	**.15*****	**.08**	**.22**	**5.23 (8)**	**.00**	**22.60**
Rehearsal	–	–	–	–	–	–	–	–	–
Elaboration	–	–	–	–	–	–	–	–	–
Organization	–	–	–	–	–	–	–	–	–
Critical thinking	–	–	–	–	–	–	–	–	–
Other	8	3	770	.13**	.07	.20	3.49(7)	0.00	12.62
Metacognitive strategies	**12**	**3**	**510**	**.27****	**.10**	**.42**	**41.24(11)*****	**32.06**	**45.44**
Goal setting and planning	4	3	510	.22	−.23	.59	29.16(3)***	3.19	86.70
Self-monitoring	–	–	–	–	–	–	–	–	–
Self-evaluation and reaction	–	–	–	–	–	–	–	–	–
Self-satisfaction	–	–	–	–	–	–	–	–	–
Metacognitive self-regulation [a]	2	2	373	.31	−.84	.95	5.39(1)*	–	81.43
Resource management strategies	**13**	**4**	**1788**	**.23***	**.03**	**.42**	**77.18(12)*****	**2.65**	**84.57**
Time and study environment	–	–	–	–	–	–	–	–	–
Effort regulation	4	2	333	.05	−.18	.27	3.34(3)	0.00	47.86
Help seeking	4	2	333	.06	−.30	.40	6.56(3)†	0.00	76.50
Peer learning	–	–	–	–	–	–	–	–	–
Other	4	2	375	.30	−.21	.68	14.72(3)**	0.00	88.09
Composite score	**10**	**6**	**2274**	**.27*****	**.17**	**.37**	**72.89(9)*****	**15.87**	**68.54**

Note. Dashes indicate that no meta-analysis was performed due to the limited number of primary studies; SRL = self-regulated learning. *k* = number of effect sizes; *m* = number of primary studies; *n* = total sample size; *r* = average correlation; CI = confidence interval; LL = lower limit. UL = upper limit.
†$p < .10$.
*$p < .05$.
**$p < .01$.
***$p < .001$.
[a] Traditional two-level meta-analysis (variance components: sampling variance and variance between studies) was performed because only one effect size was reported per study (restricted maximum-likelihood estimation and the Knapp and Hartung, 2003 method were used to compute the models).

7.4. Research question 3: Moderator analyses

As shown in Table 10, operationalization of variables, setting, and work-relatedness were detected as significant moderators. The relationship between SRL strategies and achievement motivation was significantly stronger for subjective measures of SRL strategies than for objective measures in the pooled meta-analysis and in the meta-analysis focusing on metacognitive strategies. Further, the relationship between SRL strategies and learner satisfaction was significantly stronger for subjective than for objective measures of SRL strategies in the pooled meta-analysis and in the meta-analyses focusing on metacognitive and resource management strategies. The relationship between cognitive strategies and learner engagement was significantly stronger for subjective measures of learner engagement than for objective measures. The relationship between metacognitive strategies and achievement motivation was stronger for CE activities delivered completely online than for CE activities that included face-to-face sessions. Finally, the relationship between resource management strategies and achievement motivation was stronger for non-work-related than for work-related CE activities. All other moderator analyses were not significant. Results of the omnibus tests of moderators and the amounts of residual heterogeneity not explained by the moderators are presented in Table 11.

8. Discussion

SRL strategies have been considered key competences for CE (Haemer et al., 2017; Kittel et al., 2021). Our systematic review and meta-analysis investigated factors associated with learners' use of SRL strategies in CE. Several learning process-related (e.g., achievement motivation), learner-related (e.g., prior knowledge), CE-related (e.g., peer interaction), and work-related (e.g., organizational learning culture) factors associated with SRL strategies in CE were identified. Operationalization of variables as well as setting and work-relatedness of the CE activity were identified as moderators.

8.1. Interpretation of results and theoretical implications

8.1.1. Learning process-related factors

While previous systematic reviews and meta-analyses have identified relationships between SRL strategies and achievement motivation, learning performance, and goal achievement (Lee et al., 2019; Sitzmann & Ely, 2011), our systematic review and meta-analysis detected several additional learning process-related factors associated with SRL strategies in CE. For example, our meta-analysis revealed significant positive relationships between SRL strategies and learner engagement as well as learner satisfaction.

Table 10
Regression coefficients for moderators and their 95% confidence intervals.

SRL strategies	Intercept	Op. SRL strategies [a]	Op. associated factor [a]	Setting [b]	Work-relatedness [c]	Formality [d]
Achievement motivation						
Pooled	.36*** [.21, .49]	−.32*** [−.47, −.14]	–	−.10 [−.26, .05]	−.00 [−.16, .15]	.09 [−.07, .25]
Cognitive strategies	.44* [.10, .69]	–	–	−.18 [−.48, .17]	−.11 [−.43, .22]	−.16 [−.40, .09]
Metacognitive strategies	.43*** [.30, .55]	−.39*** [−.49, −.27]	–	−.13* [−.25, −.01]	−.05 [−.18, .08]	−.03 [−.20, .14]
Resource management strategies	.19** [.06, .33]	−.18† [−.38, .02]	–	−.08 [−.21, .04]	.14* [.01, .26]	.13 [−.08, .33]
Composite score	.50** [.21, .71]	–	–	−.17 [−.49, .19]	−.11 [−.45, .24]	.05 [−.35, .43]
Learning performance						
Pooled	.44† [−.01, .74]	−.18 [−.68, .43]	−.06 [−.26, .14]	−.30 [−.70, .25]	.35 [−.11, .68]	.27 [−.08, .55]
Cognitive strategies	.12 [−.12, .36]	–	−.00 [−.30, .30]	−.03 [−.50, .44]	–	.07 [−.21, .34]
Metacognitive strategies	.31 [−.20, .69]	.05 [−.54, .60]	–	–	–	.26 [−.33, .70]
Resource management strategies	.39 [−.19, .76]	.10 [−.56, .68]	−.02 [−.25, .22]	−.36 [−.81, .34]	–	.26 [−.26, .67]
Composite score	.62*** [.41, .77]	–	–	−.32† [−.61, .04]	–	–
Learner engagement						
Pooled	.24 [−.54, .80]	.22 [−.50, .76]	−.08 [−.19, .03]	.07 [−.61, .69]	.01 [−.59, .60]	.25 [−.41, .74]
Cognitive strategies	.55 [−.64, .96]	.20 [−.72, .87]	−.08** [−.13, −.03]	−.35 [−.95, .81]	−.48 [−.93, .54]	–
Metacognitive strategies	.38 [−.69, .93]	.14 [−.77, .87]	−.08 [−.19, .02]	.27 [−.71, .90]	−.26 [−.82, .55]	–
Resource management strategies	.19 [−.22, .54]	–	–	–	.01 [−.52, .53]	–
Composite score of SRL strategies	.25 [−.55, .81]	–	–	.29 [−.47, .80]	.07 [−.59, .67]	–
Learner satisfaction						
Pooled	.33* [.02, .59]	−.37* [−.61, −.06]	–	.03 [−.32, .38]	−.04 [−.44, .37]	–
Cognitive strategies	–	–	–	–	–	–
Metacognitive strategies	.31* [.02, .55]	−.44** [−.66, −.15]	–	.12 [−.29, .49]	–	–
Resource management strategies	.36† [−.06, .67]	−.34* [−.56, −.07]	–	−.04 [−.51, .45]	−.15 [−.58, .35]	–
Composite score	–	–	–	–	–	–
Organizational learning culture						
Pooled	.25** [.16, .34]	–	–	–	–	−.00 [−.00, .00]
Cognitive strategies	.17** [.06, .28]	–	–	–	–	−.04 [−.19, .11]
Metacognitive strategies	–	–	–	–	–	–
Resource management strategies	–	–	–	–	–	–
Composite score	–	–	–	–	–	–

Note. Regression coefficients indicate the difference in *r* between the category coded with 1 and its reference category. Dashes indicate that moderator analyses were not performed due to limited variance of moderator variables. Studies that did not report sufficient information on moderators were dropped from analyses. SRL = self-regulated learning; Op. = operationalization.
†$p < .10$.
*$p < .05$.
**$p < .01$.
***$p < .001$.
[a] 0 = subjective, 1 = objective.
[b] 0 = online, 1 = face-to-face.
[c] 0 = work-related, 1 = non-work-related.
[d] 0 = formal/non-formal, 1 = informal.

Our meta-analysis is the first meta-analysis to focus on the relationships between SRL strategies and different learning process-related factors in different types of CE. Previous meta-analyses have mainly concentrated on the relationships between SRL strategies and learning performance in K-12 (e.g., J. Li et al., 2018) and higher education (e.g., Broadbent & Poon, 2015). The average correlations between SRL strategies and learning performance in our meta-analysis (e.g., $r = .36$ for the pooled meta-analysis) tend to be higher than in previous meta-analyses focusing on K-12 (e.g., $r = .18$ in J. Li et al., 2018) and higher education (e.g., $r = .13$ in Broadbent & Poon, 2015). Although this interpretation should be treated with caution, as our meta-analysis is based on correlations, our findings suggest that the need for SRL strategies in CE might be even greater than in K-12 and higher education. Especially metacognitive and resource management strategies seem to play an important role for learning performance in CE, as average

Table 11
Omnibus tests of moderators and residual heterogeneity not explained by moderators.

SRL strategies	Omnibus test	Residual heterogeneity		
	$F(df1, df2)$	$Q(df)$	I^2_{within}	$I^2_{between}$
Achievement motivation				
Pooled ($k = 180$, $m = 22$)	3.41(4, 175)*	1224.29(175)***	56.65	30.70
Cognitive strategies ($k = 42$, $m = 12$)	1.18(3, 38)	333.88(38)***	43.11	46.59
Metacognitive strategies ($k = 75$, $m = 14$)	9.35(4, 70)***	288.83(70)***	67. 26	10.42
Resource management strategies ($k = 80$, $m = 13$)	3.29(4, 75)*	422.23(75)***	69.54	14.31
Composite score ($k = 21$, $m = 11$)	0.43(3, 17)	252.14(17)***	43.82	47.71
Learning performance				
Pooled ($k = 61$, $m = 15$)	1.33(5, 55)	1075.90(55)***	34.89	62.18
Cognitive strategies ($k = 19$, $m = 7$)	0.24(2, 16)	199.46(16)***	81.94	8.98
Metacognitive strategies ($k = 18$, $m = 6$)	0.66(2, 15)	328.99(15)***	19.68	75.43
Resource management strategies ($k = 31$, $m = 9$)	0.87(4, 26)	435.72(26)***	25.20	72.22
Composite score ($k = 8$, $m = 5$)	4.67(1, 6)†	52.17(6)***	16.96	73.48
Learner engagement				
Pooled ($k = 71$, $m = 10$)	0.73(5, 65)	699.08(65)***	6.81	92.08
Cognitive strategies ($k = 13$, $m = 5$)	3.50(4, 8)†	49.94(8)***	0.00	98.22
Metacognitive strategies ($k = 48$, $m = 5$)	0.94(4, 43)	191.03(43)***	1.92	97.02
Resource management strategies ($k = 13$, $m = 4$)	0.00(1, 11)	187.76(11)***	5.42	92.36
Composite score ($k = 10$, $m = 7$)	0.58(2, 7)	302.85(7)***	22.34	76.22
Learner satisfaction				
Pooled ($k = 29$, $m = 7$)	3.03(3, 25)*	62.43(25)***	6.76	62.93
Cognitive strategies ($k = 3$, $m = 3$)	–	–	–	–
Metacognitive strategies ($k = 19$, $m = 4$)	5.49(2, 16)*	30.79(16)**	0.00	7.75
Resource management strategies ($k = 24$, $m = 5$)	2.82(3, 20)†	47.26(20)***	23.32	53.44
Composite score ($k = 4$, $m = 3$)	–	–	–	–
Organizational learning culture				
Pooled ($k = 39$, $m = 10$)	0.10(1, 37)	240.93(37)***	12.24	73.13
Cognitive strategies ($k = 9$, $m = 4$)	0.35(1, 7)	3.98(7)	0.00	26.85
Metacognitive strategies ($k = 19$, $m = 4$)	–	–	–	–
Resource management strategies ($k = 24$, $m = 5$)	–	–	–	–
Composite score ($k = 4$, $m = 3$)	–	–	–	–

Note. Dashes indicate that moderator analyses were not performed due to limited variance of moderator variables. Studies that did not report sufficient information on moderators were dropped from analyses. SRL = self-regulated learning; k = number of effect sizes; m = number of primary studies.
†$p < .10$.
*$p < .05$.
***$p < .001$.

correlations for these strategies indicated stronger relationships than for cognitive strategies. Whereas learning is the main task of K-12 and full-time higher education students, our systematic review indicates that learners in CE have to balance learning with professional and family commitments limiting the time they have available for learning (Hosseini et al., 2020; Rabin et al., 2020). Therefore, learners' ability to efficiently plan, monitor, and evaluate their learning processes, as well as effective time management and effort regulation strategies, might be more crucial in CE than in K-12 and higher education (Milligan & Littlejohn, 2016; Vanslambrouck, Zhu, Pynoo, Thomas, et al., 2019). In our meta-analysis, the relationships between some specific metacognitive (e.g., self-monitoring) and resource management (e.g., effort regulation) strategies and learning performance were not significant. We suggest that this lack of significance might be due to low statistical power resulting from the small number of included effect sizes and primary studies, as average correlation coefficients indicated strong effects, according to Cohen (1988).

8.1.2. Learner-related factors

Previous systematic reviews have identified learner-related factors (e.g., cognitive ability, prior knowledge) associated with SRL strategies (van Houten-Schat et al., 2018; J. Wong et al., 2019). However, these systematic reviews did not focus on CE exclusively and included studies focusing on higher education. Our systematic review and meta-analysis are the first to focus on learner-related factors associated with SRL strategies in CE. While some of the learner-related factors identified in our investigations (e.g., gender, prior knowledge, CE experience) are similar to those identified in previous systematic reviews (van Houten-Schat et al., 2018; J. Wong et al., 2019), other factors from previous systematic reviews (e.g., cognitive ability; J. Wong et al., 2019) could not be replicated and might be more relevant in higher education.

The findings of our meta-analysis suggest that learner-related factors may be less relevant for SRL in CE than learning process-related and work-related factors, as only weak and partially nonsignificant relationships between SRL strategies and the learner-related factors studied in our pooled meta-analyses were revealed. However, our systematic review identified several learner-related factors (e.g., curiosity, general self-regulation) for which meta-analyses were not conducted because information on effect sizes was not sufficient. Thus, the strengths of the relationships between SRL strategies and these learner-related factors still remain unclear.

8.1.3. Continuing education-related factors

Our investigations complement the list of CE-related factors associated with SRL strategies in previous systematic reviews focusing on MOOCs and online higher education (e.g., Alonso-Mencía et al., 2020; J. Wong et al., 2019). Our findings suggest that specific instructional methods may trigger specific SRL strategies. For example, opportunities for peer interaction (e.g., discussion forums) may trigger peer learning (Janakiraman et al., 2018). Self-assessments may trigger self-evaluation and reaction (Littlejohn, Hood, Miliigan, & Mustain, 2016). According to qualitative studies included in our investigations, SRL strategies are especially important to deal with learner autonomy in online learning environments (Milligan & Littlejohn, 2016; Vanslambrouck, Zhu, Pynoo, Thomas, et al., 2019) and to persist in CE activities with a long duration (Janakiraman et al., 2018). Moreover, our findings suggest that quality indicators of the CE activity are associated with SRL strategies. For example, ease of use may be an antecedent and outcome of SRL strategies: A learning environment that is easy to use may help learners engage in SRL strategies. In turn, SRL strategies may help learners interact within the learning environment easily (An, Xi, & Yu, 2024; Lin et al., 2018).

8.1.4. Work-related factors

Our systematic review and meta-analysis provide the first comprehensive list of work-related variables associated with SRL strategies in CE. Our findings suggest that a positive organizational learning culture may motivate learners to use SRL strategies (Kittel et al., 2021). Further, high job control and job demands may empower learners to engage in active learning behavior (Karasek, 1979; Raemdonck et al., 2014), while increasing the need for effective SRL strategies (Gijbels et al., 2012). In our meta-analysis, the relationship between SRL strategies and organizational learning culture was stronger for metacognitive than for cognitive and resource management strategies. Although no statements about causality can be made, this might indicate that a positive organizational learning culture may particularly motivate learners to plan, monitor, and evaluate their work-related learning activities (Kittel et al., 2021; Lin et al., 2018). Moreover, learners' successful engagement in metacognitive strategies might help recognize work-related learning opportunities, increase learners' satisfaction with their work-related learning behavior, and, in turn, positively impact learners' perceptions of the organizational learning culture (Lin et al., 2018; Zimmerman & Schunk, 2007). Our meta-analyses for the relationships between goal setting and planning as well as metacognitive self-regulation and organizational learning culture were not significant. Again, we suggest that this may be due to low statistical power, as average correlation coefficients indicated a weak to moderate effect for goal setting and planning and a moderate effect for metacognitive self-regulation, according to Cohen (1988).

8.1.5. Moderators

According to our moderator analyses, the relationship between SRL strategies and achievement motivation, as well as the relationship between SRL strategies and learner satisfaction, tend to be stronger for subjective measures of SRL strategies than for objective measures. Moreover, the relationship between cognitive strategies and learner engagement tends to be stronger for subjective measures of learner engagement than for objective measures. These findings might indicate that subjective and objective measures of SRL strategies and learner engagement do not measure the same overall construct. Measuring SRL strategies and learner engagement using behavioral measures, particularly trace data in online learning environments, has become a popular technique (Kizilcec et al., 2017; Saint, Whitelock-Wainwright, Gašević, & Pardo, 2020). However, research has shown that trace data do not always calibrate to self-report questionnaires (Hadwin et al., 2007; van Halema, van Klaveren, Drachsler, Schmitz, & Cornelisz, 2020). Moreover, our findings suggest that the relationships between SRL strategies and achievement motivation as well as learner satisfaction are stronger if the operationalization of SRL strategies matches the operationalization of the associated factors. In all included primary studies, achievement motivation and learner satisfaction were measured subjectively using self-report questionnaires. Therefore, their association with SRL strategies may be stronger if SRL strategies are also measured subjectively and reflect learners' individual perceptions (Spector & Brannick, 2009).

Moreover, our moderator analyses identified the setting of the CE activity as a significant moderator of the relationship between metacognitive strategies and achievement motivation, with a stronger relationship for CE activities delivered completely online than for CE activities including face-to-face sessions. As suggested in qualitative studies identified in our systematic review, this might be due to the higher degrees of learner autonomy and flexibility associated with online learning (Milligan & Littlejohn, 2016; Vanslambrouck, Zhu, Pynoo, Thomas, et al., 2019) In face-to-face settings, instructors may provide external regulation and help learners set appropriate learning goals as well as plan, monitor, and adjust their learning behaviors. In online settings, instructors are less present, and the need for metacognitive strategies to self-regulate learning processes is higher (Broadbent & Poon, 2015; Milligan & Littlejohn, 2016; Nawrot & Doucet, 2014).

According to our moderator analyses, the relationship between resource management strategies and achievement motivation tends to be stronger for non-work-related CE than for work-related CE. Motivational beliefs in work-related CE may be externally regulated by the employer. For example, participation in work-related CE may be mandatory, and learners may need to adhere to specific deadlines set by the employer (Hemmler et al., 2023). In contrast, participation in non-work-related CE is less externally regulated, and learners are required to apply resource management strategies to regulate their internal and external resources (Demary et al., 2013; Hemmler et al., 2023; Nawrot & Doucet, 2014).

None of the analyses conducted for the moderator formality of the CE activity was significant. We conclude that the factors associated with SRL strategies in CE do not differ for formal/non-formal and informal CE. This is consistent with some previous works (e.g., Kittel et al., 2021; Lee et al., 2020a) suggesting that the major assumptions of SRL theories equally apply to formal, non-formal, and informal CE. However, the non-significance of the moderator analyses for formality might also be due to low statistical power, as some of the regression coefficients showed weak to moderate effects.

8.2. Limitations and implications for future research

Our work is subject to limitations that provide implications for future research. First, our findings might be biased because we only considered studies published in English and in peer-reviewed journals. When conducting systematic reviews and meta-analyses, researchers face the dilemma of choosing between bias due to low-quality primary studies and publication bias. To guarantee a minimum level of quality and to avoid the garbage-in-garbage-out problem, we decided to include studies published in peer-reviewed journals only (Egger et al., 2001). This might have increased publication bias, as unpublished and informally published studies were not considered (Borenstein et al., 2009). The three-level version of the Egger's regression test (Fernández-Castilla et al., 2021; Rodgers & Pustejovsky, 2021) revealed no statistically significant asymmetry in funnel plots for our pooled meta-analyses, suggesting no publication bias. However, reliable methods for detecting publication bias in three-level meta-analyses are still lacking, and research has shown that the three-level version of the Egger's regression test may suffer from a lack of statistical power (Rodgers & Pustejovsky, 2021). Therefore, results of the three-level version of the Egger's regression test need to be interpreted with caution, and future research should include a more comprehensive search of publications.

Second, our meta-analytic results indicate heterogeneity in effect sizes which could not be fully explained by our moderators. Therefore, more research on moderators is needed. The learning process-related, learner-related, CE-related, and work-related factors identified in our investigations may serve as a starting point for future moderator analyses, as research has suggested that these factors may interact with each other (Lin et al., 2018; Zimmerman & Schunk, 2007).

Third, our meta-analysis is based on correlational findings, and no statements about causality can be made. Our findings do not allow to draw any conclusions about whether the factors investigated in our meta-analysis represent antecedents or outcomes of SRL strategies. Therefore, future research and meta-analyses should focus on experimental studies investigating SRL strategies in CE.

8.3. Practical implications

Our findings help understand the nature of SRL in CE and provide a sound basis for designing interventions to support SRL. Although this implication should be considered with caution, as no statements about causality can be made, our meta-analysis provides first indications that supporting learners' use of SRL strategies might be beneficial to enhance achievement motivation, learning performance, learner engagement, and learner satisfaction in CE.

J. Wong et al. (2021) and Jansen et al. (2020) designed and evaluated interventions aiming to support SRL in CE. These interventions consisted of a writing activity where learners should reflect on their learning goals as well as explanation videos on SRL strategies. However, these interventions had limited effects on SRL strategies, and in Jansen et al.'s study, several learners did not actively engage with the intervention. Since time is a rare commodity in CE (Eriksson et al., 2017; Hosseini et al., 2020), we suggest that the interventions designed by J. Wong and Jansen et al. might have required too much time and effort in addition to learning activities.

Whereas interventions to support SRL may be beneficial in different types of CE, they might be particularly important in online and non-work-related CE, according to our moderator analyses. Regarding online CE, the increasing use of digitally-supported learning environments offers new opportunities for supporting SRL through learning analytics (Araka et al., 2020; Schumacher & Ifenthaler, 2018). Learning analytics refer to the use of static and dynamic data about learners and learning environments, for real-time modeling, analysis, prediction, and support of learning processes (Ifenthaler, 2015; Ifenthaler & Yau, 2020; B. T. Wong & Li, 2020). When learners interact in digitally-supported learning environments, vast amounts of education-related data can be collected, providing useful insights into learning behavior and SRL processes that might be used to design personalized interventions (Pérez-Álvarez, Maldonado-Mahauad, Sharma, Sapunar-Opazo, & Pérez-Sanagustín, 2020; Schumacher & Ifenthaler, 2018). For example, trace data can be analyzed to draw inferences about how learners self-regulate and can be provided to learners in the form of personalized dashboards (Matcha, Gašević, & Pardo, 2019; Pérez-Álvarez et al., 2020). Such interventions may support SRL strategies without requiring learners to spend much additional time and effort on SRL interventions (Nawrot & Doucet, 2014; Pérez-Álvarez et al., 2020). However, to effectively support SRL through learning analytics, learning analytics need to be more firmly grounded in SRL theory, and valid frameworks for measuring SRL strategies through trace data need to be developed (Giannakos & Cukurova, 2023; Marzouk et al., 2016).

Finally, our findings have implications for work organizations by suggesting that work-related factors are associated with SRL strategies in CE. Work organizations should create an organizational learning culture supporting employees' engagement in CE activities as well as a challenging work environment supporting employees' autonomy and control over their work tasks (Gijbels et al., 2012; Kittel et al., 2021; Raemdonck et al., 2014). Although these interpretations are based on correlative findings and should be treated with caution, work organizations may play a relevant role in learners' motivation and ability to engage in SRL strategies (Gijbels et al., 2012; Kittel et al., 2021). In this regard, organizations may allow employees to spend a certain amount of their working time on CE activities, as CE often clashes with professional commitments (Vanslambrouck, Zhu, Pynoo, Thomas, et al., 2019).

8.4. Conclusion

Due to the fast-paced nature of today's (working) world, individuals are constantly required to participate in CE activities and to engage in SRL processes (Kittel et al., 2021; Manuti et al., 2015; Nawrot & Doucet, 2014). Our systematic review and meta-analysis identified learning process-related, learner-related, CE-related, and work-related factors associated with SRL strategies in CE, as well as variables moderating the underlying relationships. Our investigations help understand the nature of SRL in CE and provide a sound

basis for designing interventions to support SRL in CE.

Funding information

This work was supported by the German Federal Ministry of Education and Research as well as the German Federal Institute for Vocational Education and Training [funding reference 21INVI01]. Funders were not involved in any stage of the meta-analytic process, nor in the writing or submission process.

CRediT authorship contribution statement

Yvonne M. Hemmler: Conceptualization, Methodology, Formal analysis, Investigation, Data curation, Writing – original draft, Writing – review & editing, Visualization, Project administration. **Dirk Ifenthaler:** Validation, Writing – review & editing, Supervision, Funding acquisition.

Declaration of competing interest

Yvonne M. Hemmler: None.
Dirk Ifenthaler: None.

Data availability

Data will be made available on request.

Acknowledgements

We thank Julia Spuck for her assistance with literature search, study coding, and manuscript preparation.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.edurev.2024.100629.

References

References marked with an asterisk indicate studies included in the systematic review and meta-analysis

Aeon, B., & Aguinis, H. (2017). It's about time: New perspectives and insights on time management. *Academy of Management Perspectives, 31*(4), 309–330. https://doi.org/10.5465/amp.2016.0166

* Agonács, N., Matos, J. F., Bartalesi-Graf, D., & O'Steen, D. N. (2020). Are you ready? Self-determined learning readiness of language MOOC learners. *Education and Information Technologies, 25*(2), 1161–1179. https://doi.org/10.1007/s10639-019-10017-1.

Agyepong, E. B., & Okyere, E. D. (2018). Analysis of the concept continuing education in nursing education. *Journal of Education and Educational Development, 5*(1), 96–107. https://doi.org/10.22555/joeed.v5i1.1598

Akçayır, G., & Akçayır, M. (2018). The flipped classroom: A review of its advantages and challenges. *Computers & Education, 126*, 334–345. https://doi.org/10.1016/j.compedu.2018.07.021

Alexander, R. A., Scozzaro, M. J., & Borodkin, L. J. (1989). Statistical and empirical examination of the chi-square test for homogeneity of correlations in meta-analysis. *Psychological Bulletin, 106*(2), 329–331. https://doi.org/10.1037/0033-2909.106.2.329

* Alonso-Mencía, M. E., Alario-Hoyos, C., Estévez-Ayres, I., & Kloos, C. D. (2021). Analysing self-regulated learning strategies of MOOC learners through self-reported data. *Australasian Journal of Educational Technology, 37*(3), 56–70. https://doi.org/10.14742/ajet.6150.

Alonso-Mencía, M. E., Alario-Hoyos, C., Maldonado-Mahauad, J., Estévez-Ayres, I., Pérez-Sanagustín, M., & Delgado Kloos, C. (2020). Self-regulated learning in MOOCs: Lessons learned from a literature review. *Educational Review, 72*(3), 319–345. https://doi.org/10.1080/00131911.2019.1566208

An, F., Xi, L., & Yu, J. (2024). The relationship between technology acceptance and self-regulated learning: The mediation roles of intrinsic motivation and learning engagement. *Education and Information Technologies, 29*(3), 2605–2623. https://doi.org/10.1007/s10639-023-11959-3

Araka, E., Maina, E., Gitonga, R., & Oboko, R. (2020). Research trends in measurement and intervention tools for self-regulated learning for e-learning environments—systematic review (2008–2018). *Research and Practice in Technology Enhanced Learning, 15*(1). https://doi.org/10.1186/s41039-020-00129-5. Article e6.

Assink, M., & Wibbelink, C. J. M. (2016). Fitting three-level meta-analytic models in R: A step-by-step tutorial. *The Quantitative Methods for Psychology, 12*(3), 154–174. https://doi.org/10.20982/tqmp.12.3.p154

Attewell, P. (1990). What is skill? *Work and Occupations, 17*(4), 422–448. https://doi.org/10.1177/0730888490017004003

Barnard, L., Lan, W. Y., To, Y. M., Paton, V. O., & Lai, S.-L. (2009). Measuring self-regulation in online and blended learning environments. *The Internet and Higher Education, 12*(1), 1–6. https://doi.org/10.1016/j.iheduc.2008.10.005

Beishuizen, J., & Steffens, K. (2011). A conceptual framework for research on self-regulated learning. In R. Carneiro, P. Lefrere, K. Steffens, & J. Underwood (Eds.), *Self-regulated learning in technology enhanced learning environments: A European perspective* (pp. 3–19). Sense Publishers. https://doi.org/10.1007/978-94-6091-654-0_1.

* Birenbaum, M., & Rosenau, S. (2006). Assessment preferences, learning orientations, and learning strategies of pre-service and in-service teachers. *Journal of Education for Teaching, 32*(2), 213–225. https://doi.org/10.1080/02607470600655300.

Borenstein, M., Hedges, L. V., Higgins, J. P. T., & Rothstein, H. R. (2009). *Introduction to meta-analysis*. Wiley. https://doi.org/10.1002/9780470743386

Broadbent, J., & Poon, W. L. (2015). Self-regulated learning strategies & academic achievement in online higher education learning environments: A systematic review. *Internet and Higher Education, 27*, 1–13. https://doi.org/10.1016/j.iheduc.2015.04.007

Brunstein, J. C., & Heckhausen, H. (2018). Achievement motivation. In J. Heckhausen, & H. Heckhausen (Eds.), *Motivation and action* (3rd ed., pp. 221–304). Springer. https://doi.org/10.1007/978-3-319-65094-4_6.

Carter, R. (1985). A taxonomy of objectives for professional education. *Studies in Higher Education, 10*(2), 135–149. https://doi.org/10.1080/03075078512331378559

Cerón, J., Baldiris, S., Quintero, J., Garcia, R. R., Saldarriaga, G. L. V., Graf, S., et al. (2020). Self-regulated learning in massive online open courses: A state-of-the-art review. *IEEE Access, 9*, 511–528. https://doi.org/10.1109/ACCESS.2020.3045913

* Chaker, R., & Impedovo, M. A. (2021). The moderating effect of social capital on co-regulated learning for MOOC achievement. *Education and Information Technologies, 26*(1), 899–919. https://doi.org/10.1007/s10639-020-10293-2.

* Chen, Y.-H., & Jang, S.-J. (2019). Exploring the relationship between self-regulation and TPACK of Taiwanese secondary in-service teachers. *Journal of Educational Computing Research, 57*(4), 978–1002. https://doi.org/10.1177/0735633118769442.

* Chung, L.-Y. (2015). Exploring the effectiveness of self-regulated learning in massive open online courses on non-native English speakers. *International Journal of Distance Education Technologies, 13*(3), 61–73. https://doi.org/10.4018/IJDET.2015070105.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Lawrence Erlbaum Associates. https://doi.org/10.4324/9780203771587

* Cuyvers, K., Donche, V., & Van den Bossche, P. (2021). Unravelling the process of self-regulated learning of medical specialists in the clinical environment. *Journal of Workplace Learning, 33*(5), 375–400. https://doi.org/10.1108/JWL-09-2020-0151.

Davis, D., Chen, G., Jivet, I., Hauff, C., & Houben, G.-J. (2016). Encouraging metacognition & self-regulation in MOOCs through increased learner feedback. In S. G. Bull, B. M. Ginon, J. Kay, M. D. Kickmeier-Rust, & M. D. Johnson (Eds.), *Proceedings of the LAK 2016 workshop on learning analytics for learners* (pp. 17–22). CEUR.

* Decius, J., Schaper, N., & Seifert, A. (2021). Work characteristics or workers' characteristics? An input-process-output perspective on informal workplace learning of blue-collar workers. *Vocations and Learning, 14*, 285–326. https://doi.org/10.1007/s12186-021-09265-5.

Demary, V., Malin, L., Seyda, S., & Werner, D. (2013). *Berufliche Weiterbildung in Deutschland: Ein Vergleich von betrieblicher und individueller Perspektive [Work-related continuing education in Germany: A comparison of corporate and individual perspectives]*. German Economic Institute. https://www.econstor.eu/bitstream/10419/181848/1/iw-analysen-bd087.pdf.

Dent, A. L., & Koenka, A. C. (2016). The relation between self-regulated learning and academic achievement across childhood and adolescence: A meta-analysis. *Educational Psychology Review, 28*(3), 425–474. https://doi.org/10.1007/s10648-015-9320-8

Drubin, D. G., & Kellogg, D. R. (2012). English as the universal language of science: Opportunities and challenges. *Molecular Biology of the Cell, 23*(8), 1399. https://doi.org/10.1091/mbc.e12-02-0108, 1399.

Eccles, J. S. (1983). Expectancies, values, and academic behaviors. In J. T. Spence (Ed.), *Achievement and achievement motives: Psychological and sociological approaches* (pp. 75–146). Freeman.

Eccles, J. S., & Wigfield, A. (2020). From expectancy-value theory to situated expectancy-value theory: A developmental, social cognitive, and sociocultural perspective on motivation. *Contemporary Educational Psychology, 61*. https://doi.org/10.1016/j.cedpsych.2020.101859. Article e101859.

Eccles, J. S., & Wigfield, A. (2023). Expectancy-value theory to situated expectancy-value theory: Reflections on the legacy of 40+ years of working together. *Motivation Science, 9*(1), 1–12. https://doi.org/10.1037/mot0000275

Egger, M., George, D. S., Schneider, M., & Minder, C. (1997). Bias in meta-analysis detected by a simple, graphical test. *British Medical Journal, 315*, 629–634. https://doi.org/10.1136/bmj.315.7109.629

Egger, M., Smith, G. D., & Sterne, J. A. (2001). Uses and abuses of meta-analysis. *Clinical Medicine, 1*(6), 478–484. https://doi.org/10.7861/clinmedicine.1-6-478

Elliot, A. J., Gable, S. L., & Mapes, R. R. (2006). Approach and avoidance motivation in the social domain. *Personality and Social Psychology Bulletin, 32*(3), 378–391. https://doi.org/10.1177/0146167205282153

Eraut, M. (2004). Informal learning in the workplace. *Studies in Continuing Education, 26*(2), 247–273. https://doi.org/10.1080/158037042000225245

Eriksson, T., Adawi, T., & Stöhr, C. (2017). "Time is the bottleneck": A qualitative study exploring why learners drop out of MOOCs. *Journal of Computing in Higher Education, 29*(1), 133–146. https://doi.org/10.1007/s12528-016-9127-8

* Fan, Y., Matcha, W., Uzir, N.a. A., Wang, Q., & Gašević, D. (2021). Learning analytics to reveal links between learning design and self-regulated learning. *International Journal of Artificial Intelligence in Education, 31*(4), 980–1021. https://doi.org/10.1007/s40593-021-00249-z.

Fernández-Castilla, B., Declercq, L., Jamshidi, L., Beretvas, S. N., Onghena, P., & Van den Noortgate, W. (2021). Detecting selection bias in meta-analyses with multiple outcomes: A simulation study. *The Journal of Experimental Education, 89*(1), 125–144. https://doi.org/10.1080/00220973.2019.1582470

Fong, C. J., Krou, M. R., Johnston-Ashton, K., Hoff, M. A., Lin, S., & Gonzales, C. (2021). LASSI's great adventure: A meta-analytic review of the learning and study strategies inventory and academic outcomes. *Educational Research Review, 34*. https://doi.org/10.1016/j.edurev.2021.100407. Article e100407.

* Fontana, R. P., Milligan, C., Littlejohn, A., & Margaryan, A. (2015). Measuring self-regulated learning in the workplace. *International Journal of Training and Development, 19*(1), 32–52. https://doi.org/10.1111/ijtd.12046.

Further and higher education act. (1992). *The national archives*. https://www.legislation.gov.uk/ukpga/1992/13/contents.

* Geller, D., & Bamberger, P. A. (2012). The impact of help seeking on individual task performance: The moderating effect of help seekers' logics of action. *Journal of Applied Psychology, 97*(2), 487–497. https://doi.org/10.1037/a0026014.

Giannakos, M., & Cukurova, M. (2023). The role of learning theory in multimodal learning analytics. *British Journal of Educational Technology, 54*(5), 1246–1267. https://doi.org/10.1111/bjet.13320.

* Gijbels, D., Raemdonck, I., Vervecken, D., & Van Herck, J. (2012). Understanding work-related learning: The case of ICT workers. *Journal of Workplace Learning, 24*(6), 416–429. https://doi.org/10.1108/13665621211250315.

Grant, A. M., Franklin, J., & Langford, P. (2002). The self-reflection and insight scale: A new measure of private self-consciousness. *Social Behavior and Personality, 30*(8), 821–835. https://doi.org/10.2224/sbp.2002.30.8.821

Greene, J. A., & Azevedo, R. (2007). A theoretical review of Winne and Hadwin's model of self-regulated learning: New perspectives and directions. *Review of Educational Research, 77*(3), 334–372. https://doi.org/10.3102/00346543030395

Griffin, M. L., Hogan, N. L., Lambert, E. G., Tucker-Gail, K. A., & Baker, D. N. (2010). Job involvement, job stress, job satisfaction, and organizational commitment and the burnout of correctional staff. *Criminal Justice and Behavior, 37*(2), 239–255. https://doi.org/10.1177/0093854809351682

* Guajardo Leal, B. E. (2019). Student engagement as a predictor of xMOOC completion: An analysis from five courses on energy sustainability. *Online Learning, 23*(2), 105–123. https://doi.org/10.24059/olj.v23i2.1523.

Hackman, J. R., & Oldham, G. R. (1975). Development of the job diagnostic survey. *Journal of Applied Psychology, 60*(2), 159–170. https://doi.org/10.1037/h0076546

Hadwin, A. F., Nesbit, J. C., Jamieson-Noel, D., Code, J., & Winne, P. H. (2007). Examining trace data to explore self-regulated learning. *Metacognition and Learning, 2*(2), 107–124. https://doi.org/10.1007/s11409-007-9016-7

* Haemer, H. D., Borges-Andrade, J. E., & Cassiano, S. K. (2017). Learning strategies at work and professional development. *Journal of Workplace Learning, 29*(6), 490–506. https://doi.org/10.1108/JWL-05-2016-0037.

Halverson, L. R., & Graham, C. R. (2019). Learner engagement in blended learning environments: A conceptual framework. *Online Learning, 23*(2), 145–178. https://doi.org/10.24059/olj.v23i2.1481

* Handoko, E., Gronseth, S. L., McNeil, S. G., Bonk, C. J., & Robin, B. R. (2019). Goal setting and mooc completion: A study on the role of self-regulated learning in student performance in massive open online courses. *International Review of Research in Open and Distance Learning, 20*(3), 40–58. https://doi.org/10.19173/irrodl.v20i4.4270.

Harrer, M., Cuijpers, P., Furukawa, T., & Ebert, D. (2021). *Doing meta-analyses with R: A hands-on guide*. CRC Press.

Heidelberg University. (2023). Master's degree programmes for continuing education. from https://www.uni-heidelberg.de/en/study/application-enrolment/starting-your-degree-course-in-the-first-academic-semester/masters-degree-programmes-for-continuing-education. (Accessed 23 August 2023).

Hemmler, Y. M., & Ifenthaler, D. (2022). Indicators of the learning context for supporting personalized and adaptive learning environments. In M. Chang, N.-S. Chen, M. Dascalu, D. G. Sampsom, A. Tlili, & S. Trausan-Matu (Eds.), *2022 international conference on advanced learning technologies (ICALT)* (pp. 61–65). IEEE. https://doi.org/10.1109/ICALT55010.2022.00026.

Hemmler, Y. M., Rasch, J., & Ifenthaler, D. (2023). A categorization of workplace learning goals for multi-stakeholder recommender systems: A systematic review. *TechTrends, 67*, 98–111. https://doi.org/10.1007/s11528-022-00777-y

Hofstede, G. (1984). *Culture's consequences: International differences in work-related values* (Vol. 5). Sage.

* Hosseini, H. M., Ejtehadi, A., & Hosseini, M. M. (2020). Flipping microlearning-based EFL classroom to enhance learners' self-regulation. *Language Teaching Research Quarterly, 20*, 43–59. https://doi.org/10.32038/ltrq.2020.20.03.

* Hughes, A. J. (2019). Measuring metacognitive awareness: Applying multiple, triangulated, and mixed-methods approaches for an encompassing measure of metacognitive awareness. *Journal of Technology Education, 30*(2), 3–20. https://doi.org/10.21061/jte.v30i2.a.1.

Ifenthaler, D. (2015). Learning analytics. In J. M. Spector (Ed.), *The SAGE encyclopedia of educational technology* (Vol. 2, pp. 447–451). SAGE. https://doi.org/10.4135/9781483346397.

Ifenthaler, D., & Yau, J. Y.-K. (2020). Utilising learning analytics to support study success in higher education: A systematic review. *Educational Technology Research & Development, 68*(4), 1961–1990. https://doi.org/10.1007/s11423-020-09788-z

* Janakiraman, S., Watson, S. L., & Watson, W. R. (2018). Adult learners use of self-directed learning strategies in a massive open online course. *Journal of Ethnographic & Qualitative Research, 13*(2), 122–133.

* Jansen, R. S., van Leeuwen, A., Janssen, J., & Conjin, R. (2020). Supporting learners' self-regulated learning in massive open online courses. *Computers & Education, 146*. https://doi.org/10.1016/j.compedu.2019.103771. Article e103771.

* Jo, I.-H., Kim, D., & Yoon, M. (2015). Constructing proxy variables to measure adult learners' time management strategies in LMS. *Journal of Educational Technology & Society, 18*(3), 214–225.

Juhdi, N., Pa'Wan, F., Othman, N. A., & Moksin, H. (2010). Factors influencing internal and external employability of employees. *Business and Economics Journal, 11*, 1–10.

Karasek, R. A., Jr. (1979). Job demands, job decision latitude, and mental strain: Implications for job redesign. *Administrative Science Quarterly, 24*(2), 285–308. https://doi.org/10.2307/2392498

Kashdan, T. B., Disabato, D. J., Goodman, F. R., & McKnight, P. E. (2020). The Five-Dimensional Curiosity Scale Revised (5DCR): Briefer subscales while separating overt and covert social curiosity. *Personality and Individual Differences, 157*. https://doi.org/10.1016/j.paid.2020.109836. Article e109836.

* Kim, D., Jung, E., Yoon, M., Chang, Y., Park, S., Kim, D., et al. (2021). Exploring the structural relationships between course design factors, learner commitment, self-directed learning, and intentions for further learning in a self-paced MOOC. *Computers & Education, 166*. https://doi.org/10.1016/j.compedu.2021.104171. Article e104171.

* Kittel, A. F. D., Kunz, R. A. C., & Seufert, T. (2021). Self-regulation in informal workplace learning: Influence of organizational learning culture and job characteristics. *Frontiers in Psychology, 12*, Article e643748. https://doi.org/10.3389/fpsyg.2021.643748.

Kizilcec, R. F., & Halawa, S. (2015). Attrition and achievement gaps in online learning. In G. Kiczales (Ed.), *Proceedings of the second Learning@Scale conference* (pp. 57–66). Association for Computing Machinery. https://doi.org/10.1145/2724660.2724680.

* Kizilcec, R. F., Pérez-Sanagustín, M., & Maldonado, J. J. (2017). Self-regulated learning strategies predict learner behavior and goal attainment in massive open online courses. *Computers & Education, 104*, 18–33. https://doi.org/10.1016/j.compedu.2016.10.001.

Klassen, R. M. (2010). Confidence to manage learning: The self-efficacy for self-regulated learning of early adolescents with learning disabilities. *Learning Disability Quarterly, 33*(1), 19–30. https://doi.org/10.1177/073194871003300102

Knapp, G., & Hartung, J. (2003). Improved tests for a random effects meta-regression with a single covariate. *Statistics in Medicine, 22*, 2693–2710. https://doi.org/10.1002/sim.1482

Knowles, M. S. (1985). Applications in continuing education for the health professions: Chapter five of Andragogy in action. *Möbius: A Journal for Continuing Education Professionals in Health Sciences, 5*(2), 80–100. https://doi.org/10.1002/chp.4760050212

Knowles, M. S., Holton, E. F., III, & Swanson, R. A. (2012). *The adult learner: The definitive classic in adult education and human resource development* (8th ed.). Routledge. https://doi.org/10.4324/9780080964249

* Kormos, J., & Csizér, K. (2014). The interaction of motivation, self-regulatory strategies, and autonomous learning behavior in different learner groups. *Tesol Quarterly, 48*(2), 275–299. https://doi.org/10.1002/tesq.129.

* Kreber, C., Castleden, H., Erfani, N., & Wright, T. (2005). Self-regulated learning about university teaching: An exploratory study. *Teaching in Higher Education, 10*(1), 75–97. https://doi.org/10.1080/1356251052000305543.

Kyndt, E., & Baert, H. (2013). Antecedents of employees' involvement in work-related learning: A systematic review. *Review of Educational Research, 83*(2), 273–313. https://doi.org/10.3102/0034654313478021

* Kyndt, E., Onghena, P., Smet, K., & Dochy, F. (2014). Employees' willingness to participate in work-related learning: A multilevel analysis of employees' learning intentions. *International Journal for Educational and Vocational Guidance, 14*(3), 309–327. https://doi.org/10.1007/s10775-014-9272-4.

Le Deist, F. D., & Winterton, J. (2005). What is competence? *Human Resource Development International, 8*(1), 27–46. https://doi.org/10.1080/1367886042000338227

Lee, D., Watson, S. L., & Watson, W. R. (2019). Systematic literature review on self-regulated learning in massive open online courses. *Australasian Journal of Educational Technology, 35*(1), 28–41. https://doi.org/10.14742/ajet.3749

* Lee, D., Watson, S. L., & Watson, W. R. (2020a). The influence of successful MOOC learners' self-regulated learning strategies, self-efficacy, and task value on their perceived effectiveness of a massive open online course. *International Review of Research in Open and Distance Learning, 21*(3), 81–98. https://doi.org/10.19173/irrodl.v21i3.4642.

* Lee, D., Watson, S. L., & Watson, W. R. (2020b). The relationships between self-efficacy, task value, and self-regulated learning strategies in massive open online courses. *International Review of Research in Open and Distance Learning, 21*(1), 23–39. https://doi.org/10.19173/irrodl.v20i5.4389.

* Li, K. (2019). MOOC learners' demographics, self-regulated learning strategy, perceived learning and satisfaction: A structural equation modeling approach. *Computers & Education, 132*, 16–30. https://doi.org/10.1016/j.compedu.2019.01.003.

Li, J.-B., Bi, S.-S., Willems, Y. E., & Finkenauer, C. (2021). The association between school discipline and self-control from preschoolers to high school students: A three-level meta-analysis. *Review of Educational Reasearch, 91*(1), 77–111. https://doi.org/10.3102/0034654320979160

Li, J., Ye, H., Tang, Y., Zhou, Z., & Hu, X. (2018). What are the effects of self-regulation phases and strategies for Chinese students? A meta-analysis of two decades research of the association between self-regulation and academic performance. *Frontiers in Psychology, 9*. https://doi.org/10.3389/fpsyg.2018.02434. Article e2434.

* Lin, X.-F., Liang, J.-C., Tsai, C.-C., & Hu, Q. (2018). The moderating role of self-regulated learning in job characteristics and attitudes towards web-based continuing learning in the airlines workplace. *Australasian Journal of Educational Technology, 34*(1), 102–115. https://doi.org/10.14742/ajet.3198.

* Littlejohn, A., Hood, M., Miliigan, C., & Mustain, P. (2016a). Learning in MOOCs: Motivations and self-regulated learning in MOOCs. *The Internet and Higher Education, 29*, 40–48. https://doi.org/10.1016/j.iheduc2015.12.003.

* Littlejohn, A., Milligan, C., Fontana, R. P., & Margaryan, A. (2016b). Professional learning through everyday work: How finance professionals self-regulate their learning. *Vocations and Learning, 9*(2), 207–226. https://doi.org/10.1007/s12186-015-9144-1.

* Lourenco, D., & Ferreira, A. I. (2019). Self-regulated learning and training effectiveness. *International Journal of Training and Development, 23*(2), 117–134. https://doi.org/10.1111/ijtd.12149.

Manning, G. (2007). Self-directed learning: A key component of adult learning theory. *Business and Public Administration Studies, 2*(2), 104–115.

Manuti, A., Pastore, S., Scardigno, A. F., Giancaspro, M. L., & Morciano, D. (2015). Formal and informal learning in the workplace: A research review. *International Journal of Training and Development, 19*(1), 1–17. https://doi.org/10.1111/ijtd.12044

Marangunić, N., & Granić, A. (2015). Technology acceptance model: A literature review from 1986 to 2013. *Universal Access in the Information Society, 14*, 81–95. https://doi.org/10.1007/s10209-014-0348-1

* Margaryan, A. (2019). Workplace learning in crowdwork: Comparing microworkers' and online freelancers' practices. *Journal of Workplace Learning, 31*(4), 250–273. https://doi.org/10.1108/JWL-10-2018-0126.
Marsick, V. J., & Watkins, K. E. (2003). Demonstrating the value of an organization's learning culture: The dimensions of the learning organization questionnaire. *Advances in Developing Human Resources, 5*(2), 132–151. https://doi.org/10.1177/1523422303005002002
Martin, F., & Bolliger, D. U. (2022). Developing an online learner satisfaction framework in higher education through a systematic review of research. *International Journal of Educational Technology in Higher Education, 19*. https://doi.org/10.1186/s41239-022-00355-5. Article e50.
Martínez-López, Z., Nouws, S., Villar, E., Mayo, M. E., & Tinajero, C. (2023). Perceived social support and self-regulated learning: A systematic review and meta-analysis. *International Journal of Educational Research Open, 5*. https://doi.org/10.1016/j.ijedro.2023.100291. Article e100291.
* Martinez-Lopez, R., Yot, C., Tuovila, I., & Perera-Rodríguez, V.-H. (2017). Online self-regulated learning questionnaire in a Russian MOOC. *Computers in Human Behavior, 75*, 966–974. https://doi.org/10.1016/j.chb.2017.06.015.
Marzouk, Z., Rakovic, M., Liaqat, A., Vytasek, J., Samadi, D., Stewart-Alonso, J., et al. (2016). What if learning analytics were based on learning science? *Australasian Journal of Educational Technology, 32*(6), 1–18. https://doi.org/10.14742/ajet.3058
Matcha, W., Gašević, D., & Pardo, A. (2019). A systematic review of empirical studies on learning analytics dashboards: A self-regulated learning perspective. *Transactions on Learning Technologies, 13*(2), 226–245. https://doi.org/10.1109/TLT.2019.2916802
McCrae, R. R., & Costa, P. T., Jr. (2004). A contemplated revision of the NEO Five-Factor Inventory. *Personality and Individual Differences, 36*(3), 587–596. https://doi.org/10.1016/S0191-8869(03)00118-1
* Milligan, C., & Littlejohn, A. (2016). How health professionals regulate their learning in massive open online courses. *The Internet and Higher Education, 31*, 113–121. https://doi.org/10.1016/j.iheduc.2016.07.005.
Misko, J. (2008). *Combining formal, non-formal and informal learning for workforce skill development*. Australian Industry Group.
* Moraes, V. V., & Borges-Andrade, J. E. (2015). Individual and contextual variables in municipal officers' workplace learning. *Journal of Workplace Learning, 27*(2), 95–111. https://doi.org/10.1108/JWL-02-2014-0020.
* Moreno-Marcos, P. M., Muñoz-Merino, P. J., Maldonado-Mahauad, J., Pérez-Sanagustín, M., Alario-Hoyos, C., & Kloos, C. D. (2020). Temporal analysis for dropout prediction using self-regulated learning strategies in self-paced MOOCs. *Computers & Education, 145*. https://doi.org/10.1016/j.compedu.2019.103728. Article e103728.
Nawrot, I., & Doucet, A. (2014). Building engagement for MOOC students: Introducing support for time management on online learning platforms. In C.-W. Chung (Ed.), *Proceedings of the 23rd international conference on world wide web* (pp. 1077–1082). Association of Computing Machinery. https://doi.org/10.1145/2567948.2580054.
Organ, D. W. (1988). *Organizational citizenship behavior: The good soldier syndrome*. Lexington.
Panadero, E. (2017). A review of self-regulated learning: Six models and four directions for research. *Frontiers in Psychology, 8*, Article e422. https://doi.org/10.3389/fpsyg.2017.00422
Panadero, E., Jonsson, A., & Botella, J. (2017). Effects of self-assessment on self-regulated learning and self-efficacy: Four meta-analyses. *Educational Research Review, 22*, 74–98. https://doi.org/10.1016/j.edurev.2017.08.004
Paul, R. C., Swart, W., Zhang, A. M., & MacLeod, K. R. (2015). Revisiting Zhang's scale of transactional distance: Refinement and validation using structural equation modeling. *Distance Education, 36*(3), 364–382. https://doi.org/10.1080/01587919.2015.1081741
* Pérez-Álvarez, R. A., Maldonado-Mahauad, J., Sharma, K., Sapunar-Opazo, D., & Pérez-Sanagustín, M. (2020). Characterizing learners' engagement in MOOCs: An observational case study using the NoteMyProgress tool for supporting self-regulation. *IEEE Transactions on Learning Technologies, 13*(4), 676–688. https://doi.org/10.1109/TLT.2020.3003220.
* Peters-Burton, E. E., & Botov, I. S. (2017). Self-regulated learning microanalysis as a tool to inform professional development delivery in real-time. *Metacognition and Learning, 12*, 45–78. https://doi.org/10.1007/s11409-016-9160-z.
Pintrich, P. R. (1999). The role of motivation in promoting and sustaining self-regulated learning. *International Journal of Educational Research, 31*(6), 459–470. https://doi.org/10.1016/S0883-0355(99)00015-4
Pintrich, P. R. (2000). The role of goal orientation in self-regulated learning. In M. Boekaerts, P. R. Pintrich, & M. Zeidner (Eds.), *Handbook of self-regulation* (pp. 451–502). Academic Press. https://doi.org/10.1016/B978-012109890-2/50043-3.
Pintrich, P. R., Smith, D. A. F., Garcia, T., & McKeachie, W. J. (1991). A manual for the use of the motivated strategies for learning questionnaire (MSLQ). *National Center for Research to Improve Postsecondary Teaching and Learning*. https://files.eric.ed.gov/fulltext/ED338122.pdf.
Pintrich, P. R., Smith, D. A. F., Garcia, T., & McKeachie, W. J. (1993). Reliability and predictive validity of the motivated strategies for learning questionnaire (MSLQ). *Educational and Psychological Measurement, 53*(3), 801–813. https://doi.org/10.1177/0013164493053003024
Podsakoff, P. M., MacKenzie, S. B., Paine, J. B., & Bachrach, D. G. (2000). Organizational citizenship behaviors: A critical review of the theoretical and empirical literature and suggestions for future research. *Journal of Management, 26*(3), 513–563. https://doi.org/10.1177/014920630002600307
* Rabin, E., Henderikx, M., Yoram, M. K., & Kalz, M. (2020). What are the barriers to learners' satisfaction in MOOCs and what predicts them? The role of age, intention, self-regulation, self-efficacy and motivation. *Australasian Journal of Educational Technology, 36*(3), 119–131. https://doi.org/10.14742/ajet.5919.
Radcliffe, D. J., & Colletta, N. J. (1989). Nonformal education. In C. J. Titmus (Ed.), *Lifelong education for adults: An international handbook* (pp. 60–64). Pergamon. https://doi.org/10.1016/B978-0-08-030851-7.50022-9.
* Raemdonck, I., Gijbels, D., & Van Groen, W. (2014). The influence of job characteristics and self-directed learning orientation on workplace learning. *International Journal of Training and Development, 18*(3), 188–203. https://doi.org/10.1111/ijtd.12028.
* Rigolizzo, M., & Zhu, Z. (2021). The ebb and flow of learning motivation: The differentiated impact of the implicit theory of intelligence on learning behaviors. *Human Resource Development Quarterly, 32*(3), 273–299. https://doi.org/10.1002/hrdq.21425.
Rodgers, M. A., & Pustejovsky, J. E. (2021). Evaluating meta-analytic methods to detect selective reporting in the presence of dependent effect sizes. *Psychological Methods, 26*(2), 141–160. https://doi.org/10.1037/met0000300
Saint, J., Whitelock-Wainwright, A., Gašević, D., & Pardo, A. (2020). Trace-SRL: A framework for analysis of microlevel processes of self-regulated learning from trace data. *Transactions on Learning Technologies, 13*(4), 861–877. https://doi.org/10.1109/TLT.2020.3027496
Schiersmann, C. (2007). *Berufliche weiterbildung [Work-related continuing education]*. VS Verlag für Sozialwissenschaften.
Schröer, L., Radunovic, C., & Völz, S. (2022). *Chancen, Herausforderungen und Potentiale von digital gestützter Weiterbildung in der Altenpflege: Empirische Befunde aus dem Projekt ADAPT [Chances, challenges, and potentials of digtally-supported continuing education in elderly care: Empirical findings of the project ADAPT]*. Institut Arbeit und Technik. https://www.iat.eu/media/forschungaktuell_2022-08.pdf.
* Schulz, M., & Roßnagel, C. S. (2010). Informal workplace learning: An exploration of age differences in learning competence. *Learning and Instruction, 20*(5), 383–399. https://doi.org/10.1016/j.learninstruc.2009.03.003.
Schumacher, C. (2018). Supporting informal workplace learning through analytics. In D. Ifenthaler (Ed.), *Digital workplace learning: Bridging formal and informal learning with digital technologies* (pp. 43–61). Springer. https://doi.org/10.1007/978-3-319-46215-8_4.
Schumacher, C., & Ifenthaler, D. (2018). Features students really expect from learning analytics. *Computers in Human Behavior, 78*, 397–407. https://doi.org/10.1016/j.chb.2017.06.030
Schunk, D. H., & Mullen, C. A. (2012). Self-efficacy as an engaged learner. In S. L. Christenson, A. L. Reschly, & C. Wylie (Eds.), *Handbook of research on student engagement*. Springer, Article 219235. https://doi.org/10.1007/978-1-4614-2018-7_10.
* Siadaty, M., Gašević, D., & Hatala, M. (2016). Measuring the impact of technological scaffolding interventions on micro-level processes of self-regulated workplace learning. *Computers in Human Behavior, 59*, 469–482. https://doi.org/10.1016/j.chb.2016.02.025.
Sitzmann, T., & Ely, K. (2011). A meta-analysis of self-regulated learning in work-related training and educational attainment: What we know and where we need to go. *Psychological Bulletin, 137*(3), 421–442. https://doi.org/10.1037/a0022777
Spector, P. E., & Brannick, M. T. (2009). Common method variance or measurement bias? The problem and possible solutions. In D. S. Buchanan, & A. Bryman (Eds.), *The SAGE Handbook of organizational research methods* (pp. 346–362). SAGE.

Spinath, B., Steinsmeier-Pelster, J., Schöne, C., & Dickhäuser, O. (2012). *SELLMO: Skalen zur Erfassung der Lern- und Leistungsmotivation [SELLMO: Scales for assessing learning and achievement motivation* (2nd ed.). Hogrefe.
Straka, G. A. (2000). Conditions promoting self-directed learning at the workplace. *Human Resource Development International, 3*(2), 241–251. https://doi.org/10.1080/136788600402708
* Tang, H. (2021). Person-centered analysis of self-regulated learner profiles in MOOCs: A cultural perspective. *Educational Technology Research & Development, 69*(2), 1247–1269. https://doi.org/10.1007/s11423-021-09939-w.
Tayfur, S. N., Prior, S., Roy, A. S., Fitzpatrick, L. I., & Forsyth, K. (2021). Adolescent psychosocial factors and participation in education and employment in young adulthood: A systematic review and meta-analyses. *Educational Research Review, 34*. https://doi.org/10.1016/j.edurev.2021.100404. Article e100404.
Tempelaar, D., Rienties, B., & Nguyen, Q. (2020). Subjective data, objective data and the role of bias in predictive modelling: Lessons from a dispositional learning analytics application. *PLoS One, 15*(6), Article e0233977. https://doi.org/10.1371/journal.pone.0233977
Theobald, M. (2021). Self-regulated learning training programs enhance university students' academic performance, self-regulated learning strategies, and motivation: A meta-analysis. *Contemporary Educational Psychology, 66*, Article e101976. https://doi.org/10.1016/j.cedpsych.2021.101976
Tinmaz, H., Lee, Y.-T., Fanea-Ivanovici, M., & Baber, H. (2022). A systematic review on digital literacy. *Smart Learning Environments, 9*(1), 1–18. https://doi.org/10.1186/s40561-022-00204-y
* Tsai, Y.-h., Lin, C.-h., Hong, J.-c., & Tai, K.-h. (2018). The effects of metacognition on online learning interest and continuance to learn with MOOCs. *Computers & Education, 121*, 18–29. https://doi.org/10.1016/j.compedu.2018.02.011.
Tynjälä, P. (2008). Perspectives into learning at the workplace. *Educational Research Review, 3*(2), 130–154. https://doi.org/10.1016/j.edurev.2007.12.001
Tynjälä, P. (2013). Toward a 3-P model of workplace learning: A literature review. *Vocations and learning, 6*(1), 11–36. https://doi.org/10.1007/s12186-012-9091-z
* van Daal, T., Donche, V., & De Maeyer, S. (2014). The impact of personality, goal orientation and self-efficacy on participation of high school teachers in learning activities in the workplace. *Vocations and Learning, 7*(1), 21–40. https://doi.org/10.1007/s12186-013-9105-5.
van Halema, N., van Klaveren, C., Drachsler, H., Schmitz, M., & Cornelisz, I. (2020). Tracking patterns in self-regulated learning using students' self-reports and online trace data. *Frontline Learning Research, 8*(3), 140–163. https://doi.org/10.14786/flr.v8i3.497
van Houten-Schat, M. A., Berkhout, J. J., Van Dijk, N., Endedijk, M. D., Jaarsma, A. D. C., & Diemers, A. D. (2018). Self-regulated learning in the clinical context: A systematic review. *Medical Education, 52*(10), 1008–1015. https://doi.org/10.1111/medu.13615
* Vanslambrouck, S., Zhu, C., Pynoo, B., Lombaerts, K., Tondeur, J., & Scherer, R. (2019). A latent profile analysis of adult students' online self-regulation in blended learning environments. *Computers in Human Behavior, 99*, 126–136. https://doi.org/10.1016/j.chb.2019.05.021.
* Vanslambrouck, S., Zhu, C., Pynoo, B., Thomas, V., Lombaerts, K., & Tondeur, J. (2019). An in-depth analysis of adult students in blended environments: Do they regulate their learning in an 'old school'way?. *Computers & Education, 128*, 75–87. https://doi.org/10.1016/j.compedu.2018.09.008.
* Versuti, F. M., Andrade, R. B. N. M., & Zerbini, T. (2020). Learning strategies in distance courses: Difference between teaching degree and extension courses. *Psicologia: Teoria e Pesquisa, 36*. https://doi.org/10.1590/0102.3772e3631. Article e3631.
Viechtbauer, W. (2010). Conducting meta-analyses in R with the metafor package. *Journal of Statistical Software, 36*(3), 1–48. https://doi.org/10.18637/jss.v036.i03
* Wan, Z., Compeau, D., & Haggerty, N. (2012). The effects of self-regulated learning processes on e-learning outcomes in organizational settings. *Journal of Management Information Systems, 29*(1), 307–340. https://doi.org/10.2753/MIS0742-1222290109.
* Warr, P., Allan, C., & Birdi, K. (1999). Predicting three levels of training outcomes. *Journal of Occupational and Organizational Psychology, 72*(3), 351–375. https://doi.org/10.1348/096317999166725.
* Warr, P., & Bunce, D. (1995). Trainee characteristics and the outcomes of open learning. *Personnel Psychology, 48*(2), 347–375. https://doi.org/10.1111/j.1744-6570.1995.tb01761.x.
Wigfield, A. (1994). Expectancy-value theory of achievement motivation: A developmental perspective. *Educational Psychology Review, 6*(1), 49–78. https://doi.org/10.1007/BF02209024
Wigfield, A., & Eccles, J. S. (2000). Expectancy–value theory of achievement motivation. *Contemporary Educational Psychology, 25*(1), 68–81. https://doi.org/10.1006/ceps.1999.1015
Wild, K.-P., & Schiefele, U. (1994). Lernstrategien im Studium: Ergebnisse zur Faktorenstruktur und Reliabilität eines neuen Fragebogens [Learning strategies of university students: Factor structure and reliability of a new questionnaire]. *Zeitschrift für Differentielle und Diagnostische Psychologie, 15*(4), 185–200.
Winne, P. H. (1996). A metacognitive view of individual differences in self-regulated learning. *Learning and Individual Differences, 8*(4), 327–353. https://doi.org/10.1016/S1041-6080(96)90022-9
Winne, P. H. (2011). A cognitive and metacognitive analysis of self-regulated learning. In D. H. Schunk, & B. J. Zimmerman (Eds.), *Handbook of self-regulation of learning and performance* (pp. 15–32). Routledge.
Winne, P. H. (2022). Modeling self-regulated learning as learners doing learning science: How trace data and learning analytics help develop skills for self-regulated learning. *Metacognition and Learning, 17*(3), 773–791. https://doi.org/10.1007/s11409-022-09305-y
Winne, P. H., & Hadwin, A. E. (1998). Studying as self-regulated learning. In D. J. Hacker, J. Dublosky, & A. C. Graesser (Eds.), *Metacognition in educational theory and practice*. Lawrence Erlbaum Associates.
Winterton, J., Le Deist, F. D., & Stringfellow, E. (2005). Typology of knowledge, skills and competences: Clarification of the concept and prototype. *Centre for European Research on Employment and Human Resources*. http://www.anc.edu.ro/wp-content/uploads/2020/11/Typology_of_Knowledge_Skills_and_Compete.pdf.
Wong, J., Baars, M., Davis, D., Van Der Zee, T., Houben, G.-J., & Paas, F. (2019). Supporting self-regulated learning in online learning environments and MOOCs: A systematic review. *International Journal of Human-Computer Interaction, 35*(4–5), 356–373. https://doi.org/10.1080/10447318.2018.1543084
* Wong, J., Baars, M., He, M., de Koning, B. B., & Paas, F. (2021). Facilitating goal setting and planning to enhance online self-regulation of learning. *Computers in Human Behavior, 124*. https://doi.org/10.1016/j.chb.2021.106913. Article e106913.
Wong, B. T., & Li, K. C. (2020). A review of learning analytics intervention in higher education (2011–2018). *Journal of Computers in Education, 7*(1), 7–28. https://doi.org/10.1007/s40692-019-00143-7
Wozniak, K. (2020). Personalize learning for adults: An emerging andragogy. In S. Yu, M. Ally, & A. Tsinakos (Eds.), *Emerging technologies and pedagogies in the curriculum* (pp. 185–198). Springer. https://doi.org/10.1007/978-981-15-0618-5_11.
Wu, Y.-C., Hsieh, L.-F., & Lu, J.-J. (2015). What's the relationship between learning satisfaction and continuing learning intention? *Procedia—Social and Behavioral Sciences, 191*, 2849–2854. https://doi.org/10.1016/j.sbspro.2015.04.148
Wulf, J., Blohm, I., Leimeister, J. M., & Brenner, W. (2014). Massive open online courses. *Business & Information Systems Engineering, 6*(2), 111–114. https://doi.org/10.1007/s12599-014-0313-9
Yau, J. Y.-K., & Ifenthaler, D. (2020). Reflections on different learning analytics indicators for supporting study success. *International Journal of Learning Analytics and Artificial Intelligence for Education: International Journal of Artificial Intelligence*, (2), 4–23. https://doi.org/10.3991/ijai.v2i2.15639, 2.
Zheng, J., Lajoie, S., & Li, S. (2023). Emotions in self-regulated learning: A critical literature review and meta-analysis. *Frontiers in Psychology, 14*, Article e1137010. https://doi.org/10.3389/fpsyg.2023.1137010
* Zhu, M., Bonk, C. J., & Doo, M. Y. (2020). Self-directed learning in MOOCs: Exploring the relationships among motivation, self-monitoring, and self-management. *Educational Technology Research & Development, 68*, 2073–2093. https://doi.org/10.1007/s11423-020-09747-8.
Zimmerman, B. J. (1989). A social cognitive view of self-regulated academic learning. *Journal of Educational Psychology, 81*(3), 329–339. https://doi.org/10.1037/0022-0663.81.3.329
Zimmerman, B. J. (1990). Self-regulated learning and academic achievement: An overview. *Educational Psychologist, 25*(1), 3–17. https://doi.org/10.1207/s15326985ep2501_2
Zimmerman, B. J. (2000). Attaining self-regulation: A social cognitive perspective. In M. Boekaerts, P. R. Pintrich, & M. Zeidner (Eds.), *Handbook of self-regulation* (pp. 13–39). Academic Press. https://doi.org/10.1016/B978-012109890-2/50031-7.
Zimmerman, B. J. (2013). From cognitive modeling to self-regulation: A social cognitive career path. *Educational Psychologist, 48*(3), 135–147. https://doi.org/10.1080/00461520.2013.794676

Zimmerman, B. J., & Martinez-Pons, M. (1986). Development of a structured interview for assessing student use of self-regulated learning strategies. *American Educational Research Journal, 23*(4), 614–628. https://doi.org/10.3102/00028312023004614

Zimmerman, B. J., & Schunk, D. H. (2007). Motivation: An essential dimension of self-regulated learning. In D. H. Schunk, & B. J. Zimmerman (Eds.), *Motivation and self-regulated learning: Theory, research, and applications* (pp. 1–30). Routledge. https://doi.org/10.4324/9780203831076.

Zimmerman, B. J., & Schunk, D. H. (2011). Self-regulated learning and performance: An introduction and an overview. In D. H. Schunk, & B. J. Zimmerman (Eds.), *Handbook of self-regulation of learning and performance* (pp. 1–12). Routledge.