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The (Un)Conscious Learner: How Meta-Awareness Influences Self-Regulated Learning and Mitigates Task-Unrelated Thoughts

Daniel Ebbert,^a Caitlin Mills,^b Philip H. Winne,^c Natasha Wilson,^d
Negin Mirriahi,^e Srecko Joksimovic,^{a,e} Shane Dawson^e

^a*Centre for Change and Complexity in Learning, Adelaide University*

^b*Department of Educational Psychology, University of Minnesota*

^c*Faculty of Education, Simon Fraser University*

^d*Domestic-Pathways, Adelaide University*

^e*College of Education, Behavioural and Social Sciences, Adelaide University*

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Abstract

This theoretical article examines the relationship between self-regulated learning and task-unrelated thoughts (TUTs) through the lens of metacognition. Grounded in Winne's COPEs (conditions, operations, products, evaluations, and standards) model of self-regulated learning, we propose an interaction model emphasizing metacognitive monitoring and control. This model suggests the metacognitive cycle inherent to self-regulated learning can increase meta-awareness and mitigate prolonged experiences of TUTs. Learners can potentially redirect their focus by engaging in iterative cycles of metacognitive monitoring and control when thoughts inevitably drift toward TUTs. Foundational concepts explored include metacognition, meta-awareness, and the COPEs facets. By synthesizing theoretical connections, processes are proposed through which learners' self-regulatory capacities may influence TUT experiences via enhanced meta-awareness. This lays the groundwork to guide future inquiries on self-regulation dynamics underlying effective learning. Empirical research is recommended to investigate the viability of this theorized mechanism linking self-regulation processes to experiences of TUT and research agendas following from this theoretical framework are outlined.

Keywords: COPEs; Meta-awareness; Metacognition; Mind wandering; Self-regulated learning; Task-unrelated thought

Correspondence should be sent to Daniel Ebbert, Centre for Change and Complexity in Learning, Adelaide University, 101 Currie St., Adelaide, SA, 5000, Australia. E-mail: daniel.ebbert@adelaide.edu.au, daniel.ebbert@mymail.unisa.edu.au

1. Introduction

Imagine you are reading a journal article when moments later you realize you have been thinking about something other than the article and cannot recall what you had read. This experience is ubiquitous (Killingsworth & Gilbert, 2010) as extended sustained attention is impossible (Sharpe & Tyndall, 2025). These task-unrelated thoughts (TUTs) are a normal experience, reflecting activity in the brain's default mode network (Raichle, 2015) and resulting from natural attentional fluctuations (Dixon et al., 2017). Consequently, these thoughts commonly occur throughout our daily lives across different contexts, including education and learning (Wong, Smith, McGrath, Flynn, & Mills, 2022).

A key question is: how does one react to the realization that their thoughts have drifted away from the task? Possible reactions are influenced by various factors. For example, you might simply continue the task-unrelated train of thought if its topic was more interesting than what you were previously doing. Or you might simply continue reading despite “missing” some part of the text. Alternatively, you may use that TUT as a cue that you need a break. Another option is to search for the last information you remember reading and start re-reading from that point. How do you decide which option to enact? This article focuses on identifying the possible reactions one might enact and offers some theoretical arguments for why each reaction might occur. To date, the existing research literature has primarily focused on instances where learners start TUTs—and how to mitigate that experience. As a point of difference, we specifically examine how self-regulation may shape what a learner chooses to do upon realizing they are engaged in TUTs. We explore these reactions in detail by specifically considering how the realization of having TUTs can be viewed as a trigger for self-regulation. We describe and apply existing literature on self-regulated learning to shed light on how learners might proceed in such a case. We are led to propose that self-regulated learning strategies prompting meta-awareness may balance out often reported negative effects of TUTs.

Self-regulated learning refers to an individual's active monitoring and regulation of emotions, motivation, behavior, and cognition to manage their learning process (Panadero, 2017). In contrast, TUT is the unintentional shift of attention away from a task toward TUTs. TUT is most often associated with the term “mind wandering” (Bühler et al., 2025; Mills, Raffaelli, Irving, Stan, & Christoff, 2018). Although past work has demonstrated that TUTs can occur intentionally (i.e., people can choose to direct their minds elsewhere; Seli, Risko, Smilek, & Schacter, 2016), we focus on instances when people experience TUT *unintentionally*, given that *intentional* TUTs are both definitionally and empirically within a learner's control (Phillips, Mills, D'Mello, & Risko, 2016; Seli et al., 2018). This choice is based on understanding unintentional and intentional TUTs as distinct mechanisms operating at different stages of the learning process. When learners spontaneously experience unintentional TUTs, this shift in attention occurs outside their direct control. In contrast, intentionally choosing to think about unrelated matters represents a deliberate decision to disengage from learning. While we acknowledge that unintentional TUTs themselves may vary in content and impact (e.g., future-oriented planning vs. past-oriented rumination), our theoretical framework focuses on the metacognitive processes that emerge once learners become aware of any unintentional TUT, regardless of its specific content. We examine how self-regulation

is enacted once an individual *realizes* they are experiencing TUTs while learning (because they did not volitionally control it). We do not examine the decision for engaging in TUTs in the first place. As described in later sections of this paper, unintentional TUT can occur with and without meta-awareness (i.e., one can engage in TUTs and not realize it has happened; Schooler et al., 2011). Such instances of unintentional TUT have been consistently found to be associated with reduced performance in educational tasks (Bonifacci, Viroli, Vassura, Colombini, & Desideri, 2023; Wong et al., 2022).

While self-regulated learning and TUTs have been independently studied, their interplay has received limited attention (Bühler et al., 2025). In the self-regulated learning literature, TUTs have been identified as a distraction from self-regulated learning (Brady, Kim, & Cutshall, 2021), but how self-regulated learners manage this distraction is not explored in detail. In the literature on TUTs during learning, the focus has been on determining how much TUTs affect learning and how TUTs can be mitigated, leaving the question of how learners self-regulate their learning in response to TUTs unanswered, with the notable exception of Varao-Sousa, Solman, and Kingstone (2017), who studied re-reading following TUTs. Akin to re-reading, learners skilled in self-regulated learning may already have the tactics to manage their TUTs. Alternatively, less skilled learners may benefit from guidance on how to react in this situation. This gap in understanding how learners react once they notice TUTs means we cannot identify which reaction tactics can be used to balance out the negative effects of TUTs. Only once effective reaction tactics have been identified can we advise learners on the recommended tactics that can better manage their TUTs. This article addresses this gap through a theoretical examination of the relationship between self-regulated learning, TUTs, and meta-awareness viewed through the lens of metacognition.

Additionally, a recent perspective on self-regulated learning and mind wandering has been presented by Bühler et al. (2025), who performed a systematic literature review to identify mind wandering literature and mapped the identified literature to the self-regulated learning process, multimodal data, and analysis grid framework (Molenaar et al., 2023). Their results show that while mind wandering has been studied in relation to the cognitive and metacognitive aspects of self-regulated learning, it has rarely been studied in relation to the affective and motivational aspects. Based on their mapping, they argue that it serves as a building block toward an integrative research agenda in which mind wandering is studied in relation to self-regulated learning (Bühler et al., 2025). We support this research agenda but argue that theoretical grounding is needed. In this article, we aim to provide this theoretical perspective on self-regulated and mind wandering, specifically TUTs.

The novel contribution of this paper is to argue that the metacognitive cycles inherent in self-regulated learning serve a dual function: regulating learning processes whilst simultaneously generating meta-awareness that enables learners to detect and manage TUTs as well as other features of learning processes. We propose that self-regulated learning and awareness of TUTs are not separate but interconnected processes sharing common metacognitive foundations. This theoretical integration bridges two previously distinct research domains through the lens of Winne's COPES framework (e.g., Winne, 2022). This theoretical perspective offers implications for enhancing student attention, learning tactics, and educational outcomes. The foundational concept of metacognition will be described in detail first, followed by an outline

of TUTs and their influence on learning, leading to a section on self-regulated learning based on the COPES facets of a task (Winne, 1997). Subsequently, the hypothesized relationship between self-regulated learning and TUTs is presented. Finally, implications and directions for future research are discussed.

2. Metacognition

The concept of metacognition, first introduced by Flavell (1979), refers to the awareness and control of one's cognition, or simply, thinking about one's thinking. This foundational concept enables learners to plan, monitor, and evaluate their cognitive processes, ultimately supporting more effective learning strategies and outcomes. Flavell's (1979) seminal work distinguished two primary components of metacognition: metacognitive knowledge and metacognitive experiences. *Metacognitive knowledge* encompasses individuals' knowledge and beliefs about their cognitive activities, factors influencing those processes, and strategies they can use to reach goals. *Metacognitive experiences* are reflective accounts of mental events, including TUTs. These experiences can play a vital role in informing learners about cognitive states, setting a stage for adjusting their strategies and approaches. Flavell's (1979) research underscored the critical role of metacognition in learning and problem-solving, highlighting that learners with a strong metacognitive awareness are more likely to be successful in achieving their learning objectives.

Building on Flavell's foundational work, Nelson (1990, 1996), Nelson and Narens (1994) delved deeper into the complexities of metacognition by examining two foci of processing: meta-level and object-level. The object-level consists of the primary cognitive processes individuals engage in, such as rehearsing, generating analogies or problem-solving. The meta-level refers to cognitive processes that monitor and control cognition at the object-level. Whereas metacognitive monitoring is assessing one's cognitive experience, metacognitive control involves regulating and adjusting cognition to bridge the gap perceived between the current and future goal states. Nelson's research highlights the critical role of metacognition in regulating object-level processes, ultimately affecting the efficiency and effectiveness of learning and decision-making. By exploring the interplay between metacognitive monitoring and metacognitive control, Nelson underscored the importance of understanding the various aspects of metacognition and their impact on human cognition and behavior. For example, as it relates to TUTs, learners might engage in metacognitive monitoring, leading them to realize they have wandered from the task. Applying metacognitive control could then bring the focus back on the task.

3. TUTs and learning

It is proposed that TUTs can impair the learning process as TUTs require additional cognitive resources that may otherwise be required for processing external information (Kam et al., 2011). As described by Smallwood, Fishman, and Schooler's (2007) *cascade model of inattention*, shifting focus from external tasks to internal thoughts likely disrupts the normal processing of task-related information. TUTs, even when brief, may considerably diminish

learning effectiveness and attentional focus, particularly in tasks requiring continuous engagement because a learner may miss critical information needed to make important connections across content (Smallwood, 2011). Thus, even slight distractions can lead to a progressive decrease in the quality of task performance, highlighting the necessity of tactics to maintain focus and counteract inattention.

The cascade model of inattention was expanded by D'Mello and Mills (2021), who distinguished comprehension-congruent and comprehension-incongruent thoughts. Comprehension-congruent thoughts, though occasionally divergent, support learning objectives by aiding in the construction of mental models pertinent to the learning material. Engaging in metacognitive monitoring is one form of comprehension-congruent thought. In contrast, comprehension-incongruent thoughts pose a challenge to learning efficiency. Although these thoughts could be task-related interference (i.e., thoughts that are not on the task but are still related to the learning itself; Jordano, 2018), such as reflecting on how many pages are left to read, they are not comprehension-related. As they deviate from the learning goals, these thoughts disrupt the continuous process of understanding and assimilating new information. Over time, comprehension-incongruent thoughts can lead to a cumulative decline in comprehension and retention because they impair the construction of a mental model. This phenomenon is particularly detrimental in tasks requiring prolonged attention and engagement (D'Mello & Mills, 2021). The progressive impact of comprehension-incongruent thoughts underscores their potential to initiate a downward negative effect on one's focus on the learning material, as previously described in the cascade model of inattention (Smallwood, 2011).

Realizing thoughts are task-unrelated requires a level of meta-awareness—that is, the capacity to explicitly recognize and reflect on one's mental state (Schooler et al., 2011). While this discussion focuses on cognitive aspects of meta-awareness, it should be noted that meta-awareness operates at a neurobiological level involving complex brain network interactions (see Christoff, Irving, Fox, Spreng, & Andrews-Hanna, 2016; Schooler et al., 2011, for neurobiological perspectives on why TUTs occur and how learners become aware of them). Meta-awareness is part of metacognition (Schooler & Smallwood, 2009). Therefore, the limitations of cognition also apply to meta-awareness, such that it is possible for someone only to become meta-aware about some of their thoughts and remain unaware of others (Schooler, 2002). Furthermore, individual differences that influence metacognitive ability would also influence meta-awareness (Grabman & Dodson, 2024). When meta-awareness is activated, the topic of that operation becomes the focal thought, and one might think, “Shoot, I just spaced out again, let's see: Where was I?” (Chin & Schooler, 2009, p. 34). When learners become meta-aware that they were engaged in TUTs, they have the opportunity to compare their current state relative to the goals they set earlier in their learning process. Assuming that the goals remain stable, the learner may engage in a focus-back effort (He, Chen, Li, Li, & Zhang, 2023), a form of metacognitive control, to bring themselves back on track towards the goal they had previously set. However, it is also possible that the learner is meta-aware but decides to continue the task-unrelated train of thought, at which point these thoughts become intentional (Seli et al., 2017). Since metacognition plays a crucial role in actively addressing TUTs and is a central part of self-regulated learning, we classify reacting based on meta-awareness as an act of self-regulated learning.

4. Self-regulated learning

Self-regulated learning is a framework for understanding the emotional, motivational, and cognitive aspects of learning whereby learners engage intentionally. While numerous models of self-regulated learning exist (Panadero, 2017), the COPES framework (conditions, operations, products, evaluations, and standards; Winne, 1997), combined with the metacognitive perspective presented by Winne and Hadwin (1998), was chosen. The deciding factor being that the COPES framework specifies how contextual factors influence the learning process, for instance, time on task. Additionally, it positions metacognition as a central component of self-regulated learning. This integrated approach provides a detailed framework for understanding how learners monitor and adapt their tactics in response to task demands, emphasizing the role of metacognition in guiding these adjustments to achieve their learning goals.

Winne and Hadwin (1998) proposed that self-regulated learning can be modeled across four interconnected and loosely sequenced stages distinguished by primary foci of tasks addressed in each stage. Learners can be metacognitively active throughout all stages. The first stage is task definition. Here, learners analyze the task and surrounding conditions. This analysis identifies both the affordances and constraints. The conditions can be external, such as the time available for the task, as well as internal, such as the motivation to complete the task. During this first stage, metacognitive monitoring can be used to check one's understanding of features characterizing the task and possibly engage in metacognitive control to find more information about the task or change malleable features of the learning environment. The second stage relates to goal setting and planning and builds on the first stage. The information gained from analyzing the task and context provides staging for setting goals and planning how to achieve these goals. Goals are crucial as they identify standards learners use to monitor progress and experience as the task unfolds. In this second stage, metacognition involves evaluating various learning strategies, selecting those judged more appropriate for the task, and planning the allocation or acquisition of resources and time to achieve the set goals. In the third stage, enacting study tactics and strategies, the learner works on the task *per se*. While working on the task, metacognitively active learners frequently switch between cognition and the metacognitive monitoring and control foci crucial to self-regulated learning. During monitoring, interim products of tactics and strategies—products in the domain of the task and products expressing the learner's experience of that work, such as effort spent and being on or off task—are evaluated against the standards set in the previous stage. Outcomes of this opportunistic monitoring can lead to changes in how the learner continues to work, resulting in modifications to goals and deviations from the plan set in Stage 2. The last stage, metacognitively adaptive studying, is usually enacted after completing a task or a major segment of a task. In this stage, the learner evaluates the whole study experience on this task, usually but not always, to consider improvements to studying for future iterations. It is also possible that the result of this evaluation is that the learner chooses not to approach the task in this manner again (Winne, 2011; Winne & Hadwin, 1998).

Each of the four stages are modeled by five facets of a task, summarized by the acronym COPES (Winne, 1997, 2017). Conditions are external and internal factors bearing on learning. Task conditions include factors such as resources available, context, time available and

the learning environment. Internal conditions include factors such as motivational factors and metacognitive knowledge. Operations are cognitive and metacognitive manipulations of information, the tactics, and strategies the learner uses arising as patterns among basic cognitive operations collectively referred to as SMART: searching, monitoring, assembling, rehearsing and translating. Products refer to information generated from SMART operations, tactics and strategies. Evaluations are internally generated or externally supplied feedback about the previously created products adjudicated in terms of Standards, criteria the learner chooses for assessing properties of experienced processes and generated products.

Although the COPEs framework effectively describes the five facets of a task across the four phases of the learning process, it does not fully account for the emotional and motivational factors that influence learning behavior. The AEIOU model, nested within COPEs, seeks to address this gap. These factors describe how learners' beliefs, expectations, and values shape their engagement with each part of the learning process (Winne & Marzouk, 2019). The AEIOU model outlines five contributors to a learner's self-regulation: (i) attributions learners assign to account for labeling outcomes of COPEs tasks as successes or failures, for example, ability or help from others, and emotions that accompany those attributions, for example, pride or shame; (ii) efficacy expectation represents the learner's confidence to execute selected tactics and strategies, the operations of COPEs; (iii) Incentive is the value(s) a learner associates with processes and outcomes generated by operations. These contribute to standards in COPEs; (iv) outcome expectations represent the learner's understanding or prediction about properties of products generated in a COPEs task. (v) Utility is an integrative construct arising from the preceding four facets, which a learner assembles to choose among options for cognitive and metacognitive control. The combination of these five contributors is referred to as an AEIOU package, and learners are hypothesized to choose the package they judge to have the most utility (Winne & Marzouk, 2019). The AEIOU model underscores the important and pervasive role of motivation and associated emotions in learning. Moreover, the AEIOU model theorizes direct links between motivation and emotion to elements of the COPEs model of a task. Importantly, AEIOU elements can themselves be a target for regulation when a learner exercises metacognitive control to regulate a task's conditions, operations, and standards, giving shape to evaluations about how fully and accurately conditions are identified, how effortful and successful operations may be, and whether products and the experience of generating them in one way have lesser or greater utility than another tack to engage with a task. This amalgam of constructs opens new possibilities to model how and why learners control motivation and emotion by altering their task environment, refining or replacing their tactics, and shifting benchmarks they choose to judge progress and final accomplishments (Winne, 2022).

Winne and Hadwin's (1998) model with its explicit emphasis on metacognition analyzed in relation to COPEs facets of tasks and the AEIOU package provides a structured approach for describing how learners may identify and manage TUTs throughout single and progressive cycles of self-regulated learning. The iterative metacognitive monitoring and control cycle allows learners to adapt their engagements to task requirements and their unfolding internal cognitive states, contributing to more effective and focused learning in response to TUTs. In the following, we consider two examples that illustrate this hypothesized interaction before

explaining the interplay of self-regulated learning according to the four stages of Winne and Hadwin's (1998) model with TUTs in detail.

5. Grounded examples

The first example illustrates how a productively self-regulating learner (Kara) becomes meta-aware and adjusts their learning process. The second example (Zak) illustrates how a lack of meta-awareness can lead to an ineffectively self-regulated study session.

Kara experiences TUTs during a learning task and leverages metacognitive monitoring and control to redirect her attention and adapt her studying approach. She is studying Newton's three laws of motion. Based on prior success in physics assignments (Attribution), she feels confident in her understanding of the material (Efficacy Expectation). She values doing well in physics as it is essential for her engineering major (Incentive). Before reading her textbook, she sets a goal to take detailed notes on the three laws and develop her own examples of how they apply (task definition and goal setting). She expects that taking detailed notes will help her retain the information better (Outcome Expectation) and judges this approach as the most effective way to learn the material (Utility). Following this grounded goal setting, she starts reading. She is focused and takes clear notes as she reads through sections on the first two laws. However, her concentration drifts when she gets to the third law as she begins to think about her upcoming weightlifting competition and how she needs to prepare (TUTs while enacting the study tactic of taking notes). At first, she does not notice that her note-taking has slowed and lacks the same level of detail as the notes taken on the prior two laws. After some time, she suddenly realizes (meta-awareness generated by metacognitive monitoring) she has no memory of the last few paragraphs she had read. Attributing this lapse to temporary distraction rather than inability (Attribution), Kara decides to re-read the previous page carefully and consolidate her notes (metacognitive control). However, over the next few pages, she finds her mind again going off task to weightlifting training plans and upcoming assignments. Each time she catches herself having TUTs (metacognitive monitoring), she refocuses on her reading (metacognitive control). Due to the high frequency of TUTs, Kara realizes she had retained little from the last 10 min of reading (metacognitive monitoring). Kara then reevaluates her regulatory processes. Her attribution of competence in physics remains stable, but her efficacy expectation regarding the current study approach diminishes upon recognizing its limitations during periods of frequent TUT. This metacognitive monitoring leads to revised outcome expectations, wherein Kara anticipates greater success through more active engagement strategies. The high incentive value of mastering the material remains constant, but her utility assessment now favors a shift to self-testing procedures over continued passive reading. Consequently, Kara decides to pause and quiz herself on the chapter's key points so far (metacognitive control) before continuing. She plans to add a thorough review of Newton's three laws, a reflection of stage 4 of self-regulated learning for this task. Kara thus used metacognitive monitoring and control to manage her TUTs and adapt her learning strategy. This example illustrates how a meta-aware self-regulated learner could adapt to TUTs, while the following example shows the consequences of not adapting.

Consider Zak, a nursing student preparing for a pharmacology test. He generally considers himself a capable student (Attribution). However, his anxiety about upcoming clinical placements has lowered his confidence in his ability to focus effectively (Efficacy Expectation). While constructing his study plan, Zak is preoccupied with his upcoming clinical placements. These TUTs led him to devise a study plan that lacked depth, especially in formulating complex medications. Although he recognizes the importance of the material for his future career (Incentive), his reduced confidence leads him to set lower expectations for his study session (Outcome Expectation) and choose a superficial approach to studying (Utility). As he moves into enacting his study tactics and strategies, this shallow planning results in an ineffective study session where he overlooks crucial aspects such as drug interactions and dosages. In the metacognitively adaptive studying stage, Zak reflects on his study session and realizes he focused too much on familiar topics while neglecting more challenging ones. However, he fails to link how his early TUTs led to an incomplete plan and subsequent inadequacies in his studying. He attributes his poor performance to the difficulty of the material rather than his planning and execution (Attribution), further diminishing his confidence (Efficacy Expectation). Consequently, his preparation is less comprehensive than needed, impacting his readiness and potential academic performance on his pharmacology test. This scenario highlights a subtle yet significant impact TUTs during the initial planning stage can have on study tactics and strategies engaged in Stage 3 of the self-regulated learning cycle. His lack of meta-awareness led to an ineffective study session. This effect is outlined in the following description of the cascading effect of TUTs.

6. The cascading effect of TUTs in self-regulated learning

While TUTs can occur during each stage, we assume they are most likely to arise during Stage 3, enacting study tactics and strategies because TUTs increase in frequency with task duration (Krimsky, Forster, Llabre, & Jha, 2017; Risko, Anderson, Sarwal, Engelhardt, & Kingstone, 2012), and, most of the time, learners are in Stage 3. However, TUTs during earlier stages could have a cascading negative effect on learning outcomes, similar to the previously described cascading model of inattention (Smallwood, 2011; Smallwood et al., 2007). Just as shifting focus from external tasks to internal thoughts disrupts normal processing of task-related information, which progressively degrades task performance, TUTs in a learning scenario can similarly diminish the effectiveness of each subsequent learning stage, as illustrated in Fig. 1. Starting from task definition, where initial TUTs can lead to a misinterpretation of the task, this misinterpretation can negatively influence goal setting and planning. Misaligned goals guiding the learner's enactment of study tactics and strategies further deteriorate learning, which, next, undermines metacognitively adaptive studying. Overall, a learner's reflection on their learning process based on skewed perceptions throughout a learning task builds unsound foundations for productive adaptations for future learning tasks and for shaping factors in the AEIOU package. However, this cascading effect can at any time be disrupted by the learner becoming aware of their current and past TUTs and choosing to adapt their learning process based on this information. In the following, we outline how self-regulated learning could unfold in response to TUTs.

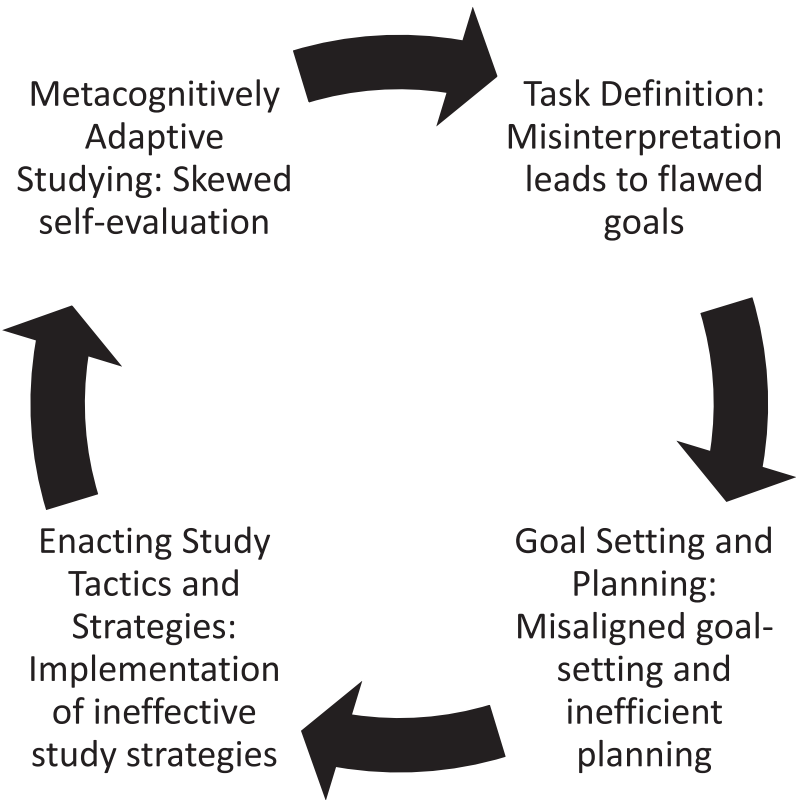


Fig. 1. Disrupted learning cycle due to task-unrelated thoughts (TUTs).

7. Self-regulated learning in response to TUTs

Exploring self-regulated learning within the perspective of Winne and Hadwin’s (1998) model illustrates how TUTs can be understood and potentially influenced. The previously outlined COPES model presents self-regulated learning as a cyclical process across four interconnected stages, and each task is modeled in terms of operations applied (SMART) according to motivational guidance (AEIOU). In the following section, each stage of the model and its facets will be described, and the potential effect(s) of TUTs on each stage. The facets of the task for each stage are also indicated in Table 1, along with an indication of which facets during which stage relate to the realization and reaction to TUTs. As we unpack these possibilities, we focus on the effect of TUTs on each stage. We acknowledge that this account is somewhat simplified by leaving aside likely moderators such as motivation or interest. We discuss these briefly later but propose it is helpful to consider TUTs in relation to each stage as a precursor to developing more complex accounts.

In each stage of the COPES model, TUTs can (and likely do) occur for learners. It is normal for learners to experience TUTs, regardless of their self-regulation capabilities. When

Table 1
Facets in the COPEs (conditions, operations, products, evaluations, and standards) typology of tasks adapted from Winne and Hadwin (1998, p. 280) to include task-unrelated thoughts (TUTs)

Facet	Definition	Stage 1: Task Definition	Stage 2: Goals and Plans	Stage 3: Enactment	Stage 4: Adaptation
Conditions	Conditions that affect how the task will be engaged, including conditional knowledge (IFs in IF-THEN rules that filter which operations are enacted)	-Interest -Goal orientation -Learning styles -Time constrains -Available resources -Knowledge of tactics -Task knowledge -Subject matter knowledge -Previous experience with similar tasks, including TUTs	-Stage 1 conditions + -Stage 1 products	-Stage 1 and 2 conditions + -Stage 2 products	-Stages 1–3 conditions + -Stages 1–3 products
Operations	Cognitive processes, tactics, and strategies the student engages to address the task	-Searching -Monitoring (including tactics such as self-questioning, charting similarities and differences; also including active metacognitive monitoring leading to meta-awareness) -Assembling (including tactics such as elaboration, integrating) -Rehearsing (including tactics such as copying notes, re-reading) -Translating (including tactics such as making diagrams, 1st-letter mnemonics)			

(Continued)

Table 1
(Continued)

Facet	Definition	Stage 1: Task Definition	Stage 2: Goals and Plans	Stage 3: Enactment	Stage 4: Adaptation
Products	Information created by operations	–Perception of what the task is, its COPES	–Standards for the task as in Stage 1 or reframed in light of individual differences (e.g., learning style) –Plan for coordinating study tactics (including how to mitigate TUTs and how to react to TUTs) –Standards for enacting tactics (e.g., speed)	–Traces of study tactics (e.g., margin notes, answers to questions, concept map) –New/reorganized subject-matter knowledge – Current contents of thought	Updates to: –COPES that distinguish tasks –motivation, beliefs and study tactics –standards for judging qualities of tactics – standards for judging TUT frequency during similar tasks
Evaluations	Feedback about products, either generated internally by the student or provided by external source(s)	Judgments about: –task understanding –COPES of the task – likelihood to experience TUTs. Comparison with other sources of information	Judgments about: –complexity/difficulty –incentive of goal –ability to carry out plan –effort required	Judgments about: –learning (calibration) –utility of tactics –efficacy –attribution – being on/off-task	Judgments about: –“distance” between prior version and adaptation –predicted effects of adaptation – overall TUT frequency. Other evaluations must await future tasks
Standards	Criteria against which products are monitored	–Grading criteria –Past performance	–Stage 1 standards and products –effort/utility thresholds –motivation orientation	–Stage 2 standards and products + object level standards and meta-level standards (including TUT status)	–Stages 1–3 standards and products

Note. All additions to cells are in bold.

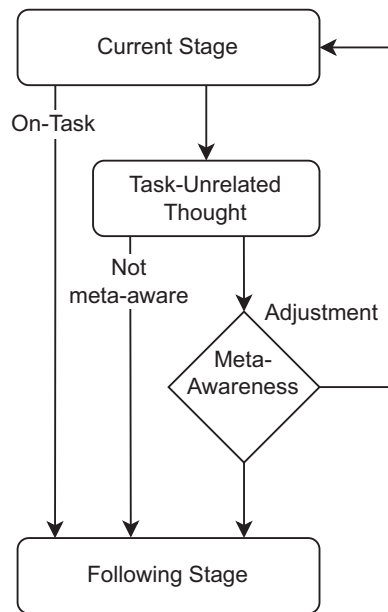


Fig. 2. Possible pathways between stages of the self-regulated learning process.

this happens, the learner might not realize they were engaged in TUTs, ultimately having a negative influence on learning outcomes (D’Mello & Mills, 2021; Smallwood, 2011), as outlined in the cascading effect of TUTs in self-regulated learning. However, it is also possible that a learner is meta-aware when TUTs arise and chooses between proceeding to the following stage without adjusting the workflow or reengaging with the task (Zedelius & Schooler, 2018). A model of these possible pathways is shown in Fig. 2. Below, we describe how TUTs may manifest in each of the four stages of self-regulated learning profiled in terms of the COPES model and how a learner may respond to their TUTs.

7.1. Stage 1: Task definition

As previously framed, in the task definition stage, the learner analyzes the requested task as well as its affordances and constraints. Externally, these include factors such as the format of learning material and internally factors such as knowledge and previous experiences with similar tasks. The Conditions at this stage of the learning process, as outlined by Winne and Hadwin (1998, p. 280), include (but are not limited to) interest, goal orientation, time constraints, available resources, knowledge of tactics, task knowledge, and subject matter knowledge. Conditions are complemented by the learner’s efficacy expectation, outcome expectation, and incentive(s) from the AEIOU package chosen by the learner (Winne, 2022). Incentive(s) include those the learner perceives to attend operations selected to engage in the task and products they expect to be generated as a result of that approach to engaging with the task. This account is modulated by previous experiences with similar tasks, which

can include whether, how often and how disruptive TUTs are the learner experienced while engaged with previous similar tasks and whether they were meta-aware of those TUTs.

As part of the Operations facet, learner's activities can be modeled using the SMART operations of searching, monitoring, assembling, rehearsing, and translating. Notably, the monitoring operation applies beyond tactics and judgments of learning. It also includes active metacognitive monitoring of whether one is on *or* off task at any given moment. These Operations result in the Products of Stage 1—the perception of the task. This perception, the first product of the task definition stage, is monitored to generate an evaluation of understanding about the task. That product can be augmented with information from other sources; one option would be for learners who are aware of how TUTs affect their learning to incorporate their anticipated likelihood of experiencing such thoughts.

Should a learner experience TUTs during Stage 1, where task understanding is developed, one result may be a misinterpretation of the task. When examining this through the COPES framework, the Products that result from the learner's Operations fail to match what would be produced if they had properly understood and engaged with the task. Consequently, they might overlook aspects of the task definition, leading to approaching the task differently. Such misinterpretation of the task, stemming from TUTs during the task definition, could alter metacognitive monitoring and control in subsequent stages. This chain of events may ultimately result in a decline in learning outcomes, traceable back to the initial TUTs.

7.2. Stage 2: Goal setting and planning

The second stage is goal setting and planning. Here, the learner uses the Products from Stage 1 (perception of the task) to develop goals for the task and plan on how to achieve these goals. The Conditions of this stage are the Products and Evaluations from Stage 1. Executing Operations results in standards for the task, a study plan, and standards describing features when study tactics are enacted, for example, rate of progress and confidence that products are on target. A metacognitively active learner who becomes aware of TUTs could include one or more of the following options in the plan:

1. Selecting study strategies and tactics that actively mitigate TUTs, such as intentionally pausing to self-question during a video or taking detailed notes while reading.
2. Intentionally engaging in frequent metacognitive monitoring, such as checking progress toward goals or evaluating the effectiveness of current tactics.
3. Planning how to react if meta-awareness identifies they are having TUTs. This plan could include resolutions such as: "If I realize I was off task while watching this lecture video, I will rewatch the last 5 minutes." Or "If I realize I was off task multiple times within a few minutes, I will take a short break."

This plan is evaluated as part of the Evaluations facet and is judged based on Standards such as complexity, difficulty, return for effort invested, goal incentive, and the learners' ability to carry out the plan. If a learner experiences TUTs during the preceding stage, this may influence their goal setting and planning in the current stage. The resultant goals and plans could be suboptimal, potentially based on an inaccurate task definition. This scenario would

potentially lead to formulating ineffective strategies for achieving these goals. However, the plan is evaluated against the Standards set in Stage 1, effort thresholds, and the learner's motivation (Standards for Stage 2). The evaluation could surface a judgment that the plan is suboptimal or that the learner had TUTs while planning.

The specific topics of thought also need to be considered during this stage. TUTs are frequently future and goal-oriented (Baird, Smallwood, & Schooler, 2011; Kvavilashvili & Rummel, 2020); such thoughts might not be harmful and could contribute to the task (Mooneyham & Schooler, 2013). In this context, these thoughts could be about how the current learning task fits the overarching study plan (lecture-related off-task thoughts) or about how well a learner understands the current task's contents (comprehension-related off-task thoughts; Kane et al., 2017). However, if TUTs are not future- or goal-oriented, this could result in formulating suboptimal goals and less effective plans. Although it is important to note that, if learners become meta-aware during this stage, they might reassess and modify their goals and plans accordingly.

7.3. Stage 3: Enacting study tactics and strategies

The third stage, enacting study tactics and strategies, is particularly relevant in understanding possible interactions with TUTs that may arise during this stage. In this stage, the learner enacts the plan made in Stage 2 (the Product of Stage 2), including components targeting the management of TUTs. If the learner had engaged in TUTs during one of the previous stages, this stage may implement suboptimal study tactics and strategies. However, suboptimal study tactics and strategies can also result from poor goal-setting and planning skills. As described in Fig. 3, the interaction between self-regulated learning and TUTs is applicable in either scenario.

At some point, the learner becomes meta-aware and realizes they are no longer processing information effectively. The Operations facet describing their current cognitive state is likely to reveal to the learner whether they were on task and what they were thinking about (part of the resulting Products generated by Operations). This information is then evaluated against the Standards of Stage 3 as part of the Evaluations facet, where learners assess the utility of their tactics integrating information in the AEIOU package, their on- or off-task status, and decide whether to make an effort to refocus (He et al., 2023). This evaluation is made against the Standards set in Stage 2 and applied in Stage 3 as well as object and meta-level standards about in-the-moment on- or off-task status (e.g., is having TUTs viewed negatively). Furthermore, Evaluations about the expected occurrence of TUTs intertwine with what the learner attributes these TUTs to and how they feel about those attributions (Attribution and Emotion from the AEIOU package). Whether a learner perceives these TUTs as unavoidable or something they could control can influence how they feel about being off task and, consequently, the Evaluation of their experience.

Should the learner choose to re-focus their thoughts on the task, they will restart the process of monitoring, evaluating, and controlling. This cyclical process repeats until the learner deems the task complete. Notably, during this iterative progression, the learner continually switches between task-focused cognitive processing and metacognitive processing,

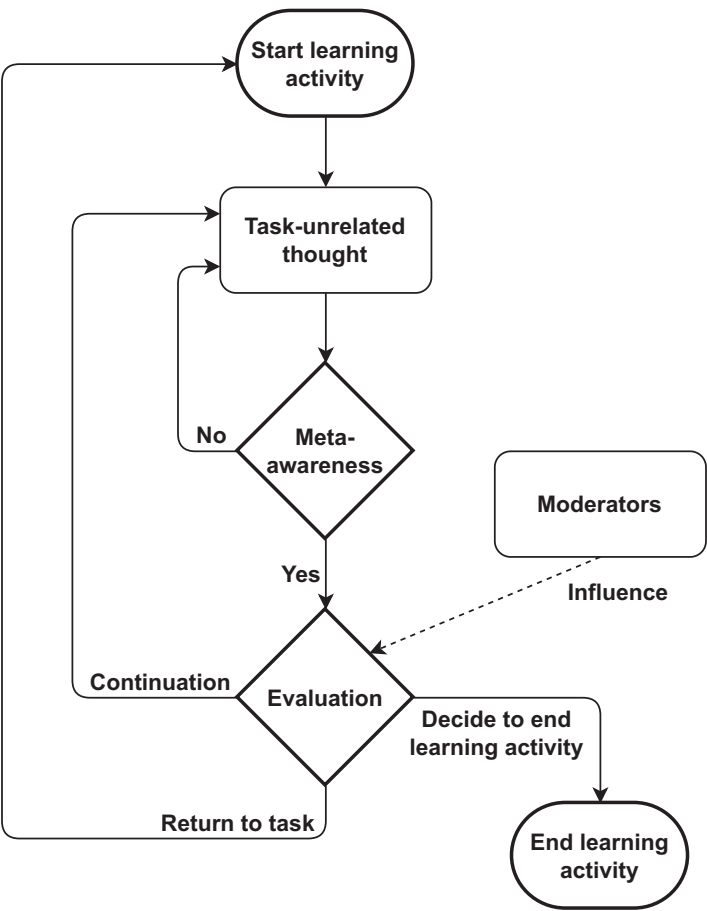


Fig. 3. Self-regulated learning and TUTs interaction model.

allowing for constant monitoring and control, resulting in adaptation. Throughout this process, metacognitive monitoring and control are activated, echoing the principles outlined earlier in the section on metacognition. Metacognitive monitoring is a part of the Operations facet and extends into Evaluations, where the learner assesses their progress (Winne & Azevedo, 2022; Winne & Hadwin, 1998). If learners find their thoughts drifting from the task during these processes, they may exercise metacognitive control, adjusting their tactics or redirecting their focus. By this mechanism, self-regulated learning can potentially manage TUTs and other distractions that might arise during the learning process. However, once the learner becomes meta-aware, they proceed to evaluate their current situation and consider which action to take, that is, how to self-regulate learning. Based on their evaluation and possibly influenced by various moderators (briefly outlined in a separate section below), they will decide on one of three options as shown in Fig. 3:

1. Return to the task, requiring a focus-back effort (He et al., 2023).

2. Continue their task-unrelated train of thought, which would result in it becoming an intentional TUT (Zedelius & Schooler, 2018).
3. Stop engaging in the task and proceed to Stage 4, metacognitively adapting studying.

If a learner chooses the first option and decides to return to the task, this choice might also include a reaction to the realization of having had TUTs. However, this is contingent on the task and context (Zedelius & Schooler, 2018). For example, a learner sitting in a live lecture or class might ask the teacher to repeat information, and a learner watching a video or reading a book would have the choice to pause and rewind the video or flip back a few pages. This evaluation, preceding an action, is the result of being meta-aware and represents a cycle of metacognitive monitoring and control, a core feature of self-regulated learning. If the learner chooses option 2, they will continue with TUTs and eventually become meta-aware again; at this point, they will be faced with the same choice again. Another reason a learner might choose Option 2 is that they deem these thoughts adaptive and, based on their evaluation, see no need to return to the task. Note these decisions or “choices” may not be part of one’s explicit (conscious) awareness and instead may be automatized, paralleling how appraisals of emotions operate (e.g., akin to appraisals in Pekrun’s, 2006, control value theory).

7.4. Stage 4: Metacognitively adaptive studying

Last, the learner either completes the task or they can exercise the choice to disengage from the task and proceed to the last stage, known as metacognitively adaptive studying. During this stage, the learner reflects on the previous learning experience, including any TUTs they were aware of and the effectiveness of their chosen study strategies and tactics for completing the task and mitigating the frequency of TUTs. The Conditions for this stage include the Conditions and Products of the preceding three stages. Operations based on these Conditions generate Products that update beliefs about the task, knowledge about and success in applying study tactics, and standards for judging similar tasks. As well, standards can be generated for judging TUT frequency during similar tasks. Evaluations the learner makes, characterizes their experience in adapting to the task using the cycle of metacognitive monitoring and control. Simply put, the learner evaluates how often they were off task and the associated consequences (or incentives) of those TUT episodes. These Evaluations are made against the Standards from the previous three stages, setting a stage for starting new tasks (previous experience as part of the Conditions of Stage 1).

In this stage, TUTs may lead to a misalignment between the actual task experience and its evaluation. This misalignment may be further compounded if the learner had TUTs in previous stages, as this could skew their perception and evaluation of the current and preceding tasks. Consequently, the learner might erroneously judge the effectiveness of a certain study strategy. However, the learner may also become aware of earlier TUTs during this stage and use that awareness as a cue for adjusting future instances of TUTs (Critcher & Gilovich, 2010). This awareness also has the potential to influence the accuracy of their assessment, evaluation of the task experience, and utility of the AEIOU package. Ideally, such self-awareness would facilitate a more accurate integration of experiences from all stages leading to a fuller and more realistic evaluation of the learning process.

8. Future research

The COPES model and the 4-stage self-regulated learning cycle (Winne & Hadwin, 1998) provide a useful framework for studying how learners manage TUTs. The framework provides several directions for future research agendas.

8.1. *Agenda 1: Empirical verification of the relationship between self-regulated learning and meta-awareness*

The theoretical application presented needs empirical investigation. The guiding research question for this research agenda would be: Do skilled self-regulated learners demonstrate higher meta-awareness of TUTs? Researchers could start by assessing if skilled self-regulated learners become increasingly meta-aware, compared to less skilled learners. These studies would require researchers to measure meta-awareness using self-caught thought reports (Chu, Marks, Smith, & Chadwick, 2023; Weinstein, 2018) along with measures of self-regulated learning. During this line of research, it would be crucial to consider whether meta-awareness is measured as the count of TUTs learners report or the proportion of TUTs they are aware of (Chu et al., 2023). Furthermore, whether self-regulated learning is measured using trace data or surveys will likely influence these results (Choi, Winne, Brooks, Li, & Shedden, 2023). Should this relationship between self-regulated learning and meta-awareness be established, controlled intervention studies, similar to the work by Randall, Hanson, and Nassrelgrgawi (2022), could directly test whether self-regulated learning-focused interventions, such as teaching learning strategies or goal setting, can boost meta-awareness. Possible outcomes of this agenda would include directionality and the effect of the relationship between self-regulated learning skills and meta-awareness, along with interventions aimed at influencing this effect.

8.2. *Agenda 2: Modeling state transitions between self-regulated learning and TUT*

The guiding question for the second research agenda is: What are the temporal dynamics between states of self-regulated learning and other states of mind? This question is motivated by the hypothesized process of learners moving between states of learning and internal states of mind, such as TUTs. While we focused on this work on TUTs, there are other states of mind learners engage in while learning, such as task-related interference (Smallwood & Schooler, 2015; Stawarczyk, Majerus, Maj, Van der Linden, & D'Argembeau, 2011), comprehension-related off-task thought, or lecture-related off-task thoughts (Kane et al., 2017). How and when learners transition between these states, whether intentional or not, could be an area of research and draw upon the work of Sharma, Stewart, Li, Ravichander, and Walker (2024), who modeled how learners transition between states of learning and TUT using sequence mapping. Possible outcomes of this line of research could be probabilistic models for whether a learner is likely to transition from learning to TUTs or task-related interference. For this line of research, a learning analytics approach is suitable, utilizing, for instance, the FLoRA engine to measure the temporal dynamics of self-regulated learning (Li et al., 2025) in combination

with employing machine learning algorithms based on behavioral and physiological signals to measure TUTs (Kuvar, Kam, Hutt, & Mills, 2023).

8.3. *Agenda 3: Identifying and testing reactive control tactics*

Assuming a relationship between self-regulated learning skills and meta-awareness is identified, the following agenda would be to study which tactics self-regulated learners have in place for exercising reactive meta-cognitive control once they realize they were having TUTs and which of those tactics balance out the negative effect of TUT. The guiding questions for this agenda would be:

1. Which reaction tactics do self-regulated learners employ after becoming aware of TUTs?
2. Which reaction tactics most effectively mitigate learning losses from TUTs?

These reaction tactics could be observed by studying how learners act after realizing TUTs in an observational study setting. Such a study could observe learners in an instrumented room with cameras capturing their behaviors while they engage in self-directed study and report instances of TUTs while also collecting detailed interaction traces from their learning materials, such as video player logs and document interactions. Qualitative analysis of this multi-modal data would reveal how learners adjust their learning strategies and behaviors in response to realizing their TUTs. Possible reaction tactics might be to re-read a few sentences or rewind a video.

After such reaction tactics have been identified, the subsequent step would be to test these reaction tactics in an experimental design in which groups of learners are instructed to react after their TUTs by employing a specified tactic, followed by a knowledge test. Those effects could be compared to a control group in a similar approach to Varao-Sousa et al. (2017) study of rereading after detecting TUTs. In addition to the impact on learning outcomes, qualitative studies could explore whether a learner's TUT content is related to their learning process, as the content of TUTs may shape conditions with implications for how a learner might operate subsequently. For example, a learner might continue a task-unrelated train of thought if it relates to an overarching goal, such as widening knowledge judged relevant to passing a course. Furthermore, it could be studied under which conditions learners become aware of their TUTs and whether awareness of those conditions correlates with widening choices about their learning tactics. Understanding these conditions and changes could be used to inform the development of context-specific recommendations for learners, for example: IF you are frequently having TUTs while reading, THEN switch to creating flashcards based on what you read; or IF you are frequently having TUTs while watching a lecture video THEN reflect on what you remember from the video by writing a summary and then rewatching parts you missed because you were having TUTs. Possible outcomes of this agenda would be an overview of reaction strategies that learners can utilize to balance out the negative effects of TUTs.

Table 2
Potential moderating factors

Moderating Factor	Relevance
Thought content	1. Whether the learners' thought was TUT or task-related interference (Jordano, 2018). 2. Whether the learners' thought was comprehension-congruent or comprehension-incongruent (D'Mello & Mills, 2021).
Goal orientation	Whether the learners' thought was goal-oriented (Mooneyham & Schooler, 2013).
Time on task	How often the learner already had TUTs during this task, given that TUTs increase over time (Risko et al., 2012).
Motivation	1. Motivation moderates the relationship between TUTs and task performance, with higher motivation balancing out the negative effect of TUTs (Brosowsky, DeGutis, Esterman, Smilek, & Seli, 2023; Seli, Wammes, Risko, & Smilek, 2016). 2. Higher motivation leads to an increase in meta-awareness (Zedelius, Broadway, & Schooler, 2015).
Interest	Whether the learner is interested in the subject matter, an increased interest in the subject matter correlates with less TUTs (Unsworth & McMillan, 2013).
Mood	A negative mood increases TUTs (Poerio, Totterdell, & Miles, 2013; Smallwood, Fitzgerald, Miles, & Phillips, 2009).
Attribution	Whether a learner perceives TUTs as inevitable and something to be accepted or something that they should be able to control.
Emotion	How a learner feels about their TUTs, for example, if they feel bad for having been off task and perceive TUTs as something negative.

8.4. *Agenda 4: Examining moderating factors*

Furthermore, the impacts of potential moderating factors could be assessed. While an extensive account of all factors potentially influencing meta-awareness, TUTs, and reaction to TUTs is outside the scope of this article, Table 2 outlines some potentially relevant factors for evaluating whether they focus back on the task. Each moderating factor might have a different impact on the interaction between self-regulated learning skills, meta-awareness, and the learner's reaction to realizing TUTs. Additionally, individual differences in learners' metacognitive abilities (Grabman & Dodson, 2024), their capacity for sustained attention (Sharpe & Tyndall, 2025), their inclination towards TUTs (Murphy & Brewer, 2025), and their cultural background (Sharpe & Tyndall, 2025) will need to be considered.

8.5. *Agenda 5: Pedagogical integration*

Following empirical validation of the relationship between self-regulated learning, meta-awareness, and TUTs, further research would involve translating these findings into evidence-based pedagogical practices. This agenda would examine how effective reaction tactics identified in previous research streams can be explicitly taught to learners through interventions that normalize the occurrence of TUTs while providing concrete tactics for metacognitive control. These interventions could be placed in existing self-regulated learning training programs, which have been shown to enhance students' attention, monitoring of their progress

toward a goal, and reflection on their progress while learning (Theobald, 2021). Research questions should address which instructional approaches most effectively develop students' capacity to monitor their attentional states and implement appropriate control tactics when TUTs are detected. Additionally, this agenda could explore how educators can scaffold learners' development of these metacognitive skills across different educational contexts and subject domains. Studies examining how the implementation of these interventions affects both metacognitive awareness and learning outcomes would provide valuable insights for educational practice. Particular attention should be given to how learners with varying levels of self-regulated learning skill respond to these interventions, potentially informing differentiated approaches to supporting TUT management. By connecting theoretical understandings of the self-regulated learning-TUT relationship with practical pedagogical strategies, this research agenda holds significant potential for enhancing learning effectiveness in authentic educational settings where TUTs inevitably occur.

Pending empirical validation, educators could explore provisional strategies such as periodic meta-awareness prompts during lessons, brief mindfulness exercises to enhance meta-awareness, collaborative learning tasks that promote sustained engagement, and structured reflections in which learners reflect on their learning experience. These interim approaches may aid learners in their meta-awareness necessary for detecting and managing TUTs whilst research establishes their effectiveness.

9. Conclusion

This article introduced a model embracing the interplay between metacognition, self-regulated learning, and TUTs, arguing that self-regulated learning encompasses not only strategies for learning but also mechanisms for managing TUTs through shared metacognitive processes. Applying the COPES model within the 4-stage self-regulated learning model (Winne & Hadwin, 1998) to the context of TUTs rests on the hypothesis that metacognitive monitoring and control inherent in self-regulated learning results in learners intermittently becoming meta-aware. By positioning TUTs within the 4-stage self-regulated learning model, we argue that the same monitoring-control cycles that support learning also provide natural breakpoints for meta-awareness. Once these learners realize their TUTs, they have the choice of remaining off task, re-engaging with the learning task, or ending the task. Should they re-engage with the task, they can adapt their learning process by changing the learning tactic used or updating factors involved in the preceding stages of surveying conditions and planning and goal setting. The iterative cycle of self-regulated learning describes where research could look to identify when, why, and how learners evaluate and adapt their cognitive focus and study tactics when TUTs intrude on focused studying activities. This integration suggests that strengthening self-regulated learning capabilities may simultaneously enhance learners' capacity to stay focused.

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