Proceedings of the 3rd International Conference on Social Psychology and Humanity Studies
DOI: 10.54254/2753-7048/2025.18057

Review on Epistemic Beliefs under Self-regulated Remote Learning

Tianao Gao[1,a,*]

[1]*East China Institute of Talent Science, Mental Health Education Research Center, Shanghai, China*
a. tinogao@ecits.ac
**corresponding author*

Abstract: With global education shifting online during the lockdown, extensive research on epistemic beliefs has shifted towards its implication in an online setting. During online learning, students are facing significant changes concerning online learning engagement and online academic stress reduction. Previous research indicated self-regulated learning skills are essential for students to regulate stress and increase learning engagement, with epistemic beliefs being an essential factor affecting self-regulated learning. Hence, this review sets out to establish a theoretical relationship between epistemic beliefs and stress management and learning engagement in a specific online remote learning setting. It is proposed that students who perceive knowledge as complicated or developing are more likely to self-motivate and exhibit lower level of academic stress and higher level of learning engagement.

Keywords: Epistemic Belief, Self-Regulated Learning, Academic Stress, Online Education.

1. Introduction

Lockdown during the COVID-19 pandemic in China brought about several changes to education. The greatest changes concern online learning engagement and online academic stress among students. As education has transitioned to online formats, learning engagement has suffered due to a lack of in-person interaction and the distractions that are present in home environments. Concurrently, academic stress has increased, as students and educators alike struggle to adapt to the use of new technologies and methodologies[1]. Online learning thus makes greater demands on students related to adapting to new learning settings and mental preparedness. Self-regulated learning (SRL) plays an important role in adapting to remote learning settings. Here, students with high motivation are more likely to set and pursue their academic goals diligently, despite the lack of external supervision that is inherent to online environments. Moreover, self-efficacy, or the belief in one's ability to succeed[2], significantly influences students' persistence and engagement in learning activities. Fostering SRL skills can help mitigate challenges like those reported during the COVID-19 pandemic, including decreased learning engagement, increased academic stress, and heightened anxiety[3], by promoting the use of better time-management, goal-setting, and self-monitoring strategies [4].

Epistemic beliefs may be defined as "an individual's beliefs surrounding the nature of knowledge"[5]. Pintrich, Marx and Boyle[6] state that beliefs are important in how students gather and process information. The benefits of complex epistemic beliefs include enhanced critical thinking skills, better learning outcomes, and the improved ability to engage in reflective thinking [7]. Previous

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DOI: 10.54254/2753-7048/2025.18057

research has established that epistemic beliefs are positively associated with SRL at various stages of the educational process. In task definition, for instance, epistemic beliefs relate to the affective condition of task motivation. In planning and goal-setting, students with complex epistemic beliefs tend to set greater goals, while in evaluation, students with complex epistemic beliefs have higher standards for their learning outcomes. Nevertheless, evidence supporting the impact of epistemic beliefs on SRL does not include changes in social factors, such as peer task definitions and comparisons with peers, nor does it consider the variability in information sources during remote learning prompted by lockdown conditions [5][7]. Therefore, we aim to reexamine the effect of epistemic beliefs on SRL in online learning settings and contribute to answering the hitherto neglected question of how epistemic beliefs are related to online learning engagement and online academic stress.

2. Literature review

2.1. The role of epistemic beliefs and self-regulated learning in online learning engagement

In the present study, we use Muis'[7] influential description of the role of epistemic beliefs in SRL as our theoretical framework. Muis[7] categorized SRL into four stages: In stage 1, task definition, the student becomes acquainted with the contextual conditions of a task and familiarizes themselves with those conditions[8]; in stage 2, planning and goal-setting, the student consciously or automatically searches for strategies to approach the task defined in stage 1[9]; in stage 3, enactment, the student adopts their chosen strategies to solve the task; in stage 4, evaluation, the student reflects on the success or failure of each stage and the corresponding learning outcomes. Muis[7] consequently put forth three propositions pertaining to the role of epistemic beliefs in SRL: (1) in task definition, epistemic beliefs constitute the affective condition of task motivation.(2) in planning and goal-setting, students with complex epistemic beliefs tend to set greater goals.(3) in evaluation, students with complex epistemic beliefs also have higher standards for their learning outcomes.

However, recent evidence has prompted researchers to reexamine Muis'[7] three propositions in online learning settings. The nature of knowledge and knowing is changing due to the availability of information and the ability to communicate online. During online remote learning, students have access to a broad range of learning resources and information. They also experience less stringent supervision of their academic integrity. These changes have resulted in shifts in epistemic beliefs. That is, students are more likely to believe that knowledge requires justification rather than just accepting that knowledge is handed down by authority figures, as they have more resources to verify the acquired knowledge[10]. Additionally, as the demand to memorize information decreases and online communication increases, there are more opportunities for open discussions, and more attention is being given to the development of the knowledge model. Hence, students are more likely to view knowledge as developmental and uncertain[11]. Overall, students tend to develop more sophisticated epistemic beliefs during online learning[12].

Despite concerns about the generalizability of epistemic beliefs in online learning settings, Muis'[7] three propositions have been supported by recent research in such settings. Regarding task definition—the first of Muis'[7] three propositions pertaining to the role of epistemic beliefs in SRL—students equipped with complex cognitive and affective capacities are more likely to utilize various supplemental tools when familiarizing themselves with the definition of the task. When students assess a learning task as simple or certain, they tend to work on the task individually and rely on straightforward, procedural approaches. However, when students perceive a task as complex or uncertain, they are more inclined to seek out diverse resources and collaborative tools to enhance their understanding and approach. For example, students might use online forums, digital libraries,

DOI: 10.54254/2753-7048/2025.18057

and collaborative platforms such as Google Docs to gather multiple perspectives and refine their task definitions[13].

Furthermore, students with sophisticated epistemic beliefs are likely to utilize metacognitive strategies such as self-questioning and reflective thinking, which help them to navigate the complexity of the task[14]. These students might also use educational technologies such as simulation tools and interactive learning environments to explore different aspects of the task, thereby enriching their cognitive and affective engagement[15]. For instance, in a study on medical students, it was found that those with more sophisticated epistemic beliefs make extensive use of online medical databases and peer discussion forums to supplement their learning, resulting in a more comprehensive understanding of clinical cases[16].

Regarding Muis'[7] second proposition of planning and goal-setting, online students with sophisticated epistemic beliefs tend to set higher standards for their understanding of knowledge. Since online learning environments place less emphasis on memorizing course materials, students with complex epistemic beliefs aim for a deeper comprehension and mastery of the subject matter. For instance, a study by Kizilcec and Halawa[17] found that students enrolled in massive open online courses who hold sophisticated epistemic beliefs are more likely to utilize metacognitive strategies to understand the course content more deeply. These students often utilize self-explanations, summarize information, and seek additional resources to ensure a robust grasp of the material. This contrasts with students who may rely primarily on rote memorization.

Furthermore, research that Bråten and Strømsø[18] conducted indicated that students with complicated epistemic beliefs often seek out interdisciplinary connections and real-world applications of the knowledge they acquire. This approach not only enhances their understanding but also motivates them to set and achieve greater learning goals.

Finally, during the reflection stage, students with rudimentary epistemic beliefs place more emphasis on external performance criteria, such as grades and teacher feedback, but these can be compromised due to the less stringent supervision and reduced academic integrity in online learning settings. This lack of supervision may lead to increased opportunities for academic dishonesty, thereby diminishing the reliability of external assessments[19]. As a result, these students might struggle to accurately gauge their true understanding of a topic and academic performance.

Contrastingly, students with complex epistemic beliefs prioritize internal mastery criteria, such as personal growth, understanding, and the ability to apply knowledge effectively. These internal criteria remain unaffected when transitioning to online learning settings, as they are inherently connected with the student's self-evaluation and intrinsic motivation. For instance, a student with sophisticated epistemic beliefs might focus on their ability to synthesize information from multiple sources and apply it to solving real-world problems, regardless of the format of their education[18]. An emphasis on internal mastery criteria helps students with complex epistemic beliefs to maintain high standards for their learning outcomes. They are also driven by a desire to understand and master the content, rather than simply achieve good grades. This intrinsic motivation is crucial in an online learning environment, where external motivators might be less effective[20].

As a result, epistemic beliefs and self-regulated learning (SRL) are essential in enhancing student engagement in online environments, where learners explore and develop their knowledge and understanding. Previous studies have demonstrated that self-efficacy influences engagement in online learning[21], showing that students with higher self-efficacy are more likely to invest effort, persevere through difficulties, and manage frustration effectively. Therefore, high self-efficacy plays a significant role in boosting student engagement in learning[22].

Research has consistently demonstrated that goal orientation is a key predictor of student engagement across different educational settings. In particular, mastery-goal orientation, which focuses on learning and personal improvement, has been strongly linked to higher levels of behavioral,

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cognitive, and affective engagement[23][24]. Students with a mastery-goal orientation are more likely to show greater persistence, effort, and participation in learning activities, indicating enhanced behavioral engagement[25]. Likewise, cognitive engagement, characterized by deep learning and self-regulation, is heightened in students who prioritize mastering content over merely performing[26]. Affective engagement, involving emotional connection and a sense of belonging, is also positively impacted by mastery-goal orientation, as these students become more emotionally invested in their learning environment and relationships with peers[21][27]. In contrast, performance-goal orientation, which centers on demonstrating competence in comparison to others, has shown mixed effects on engagement, with some studies suggesting it may promote surface learning and reduce cognitive and affective engagement[28].

2.2. The role of epistemic beliefs and self-regulated learning in online academic stress

The shift to online learning has been associated with heightened stress related to academic performance[29]. Academic stress occurs when educational demands exceed the resources students have to cope with those challenges[30]. A study of 1,129 students across various provinces in Indonesia identified academic workload and teaching methods as key contributors to stress in online learning during the pandemic[31]. Furthermore, factors such as time management and understanding course materials are additional stressors in online learning environments[32]. Inadequate management of these stressors can result in academic stress, negatively affecting student satisfaction. Research consistently shows an inverse relationship between academic stress and student satisfaction, with higher levels of stress leading to lower satisfaction[33].

Resilience, a psychological condition that helps individuals handle stress, mitigate the effects of adverse events, and adapt successfully to adversity, plays a critical role in online learning settings [34] since it has been found that students with high resilience are less impacted by stressors[35]. Previous studies have also reported negative correlations between stress and resilience, underscoring the role of resilience in protecting against academic stress [33][30].

Research that de la Fuente[36] conducted demonstrated a significant relationship between SRL and the strategies that university students use to cope with academic stress, particularly strategies focused on problem-solving. Jackson[37] emphasized that optimal coping skills and behavioral regulation, especially in stressful situations, should be examined within an interpersonal context. Hence, students with effective stress-coping skills can significantly reduce their academic stress.

3. Conclusion

Our findings indicate that students who exhibit stronger degrees of the mastery-goal orientation and who believe that scientific knowledge is developed through careful thought and analysis, evolves with new discoveries, and is not derived from authority figures tend to have higher online learning engagement and lower academic stress. This is because epistemic beliefs influence online learning engagement and academic stress by affecting achievement motivation and learning approaches. The results of this study also suggest that students' epistemic beliefs, achievement motivation, and self-efficacy are crucial determinants of their engagement and academic stress during online learning necessitated by a lockdown. Consequently, science educators can implement instructional strategies that foster the development of sophisticated epistemic beliefs, including clarifying students' beliefs about learning and knowledge, developing materials that promote meaningful learning, and encouraging students to go beyond the mere memorization of facts and terminology to reach a deeper understanding of the scientific explanations of phenomena. This approach enables students to become meaning-seeking students who can retain knowledge and apply it to new contexts.

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Additionally, to foster the development of adaptive motivational beliefs, educators should provide opportunities for students to make choices about and have control over their learning. Emphasis should be placed on individual improvement, learning, and understanding, allowing students to recognize the connection between personal hardwork and achievements[38][39].

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