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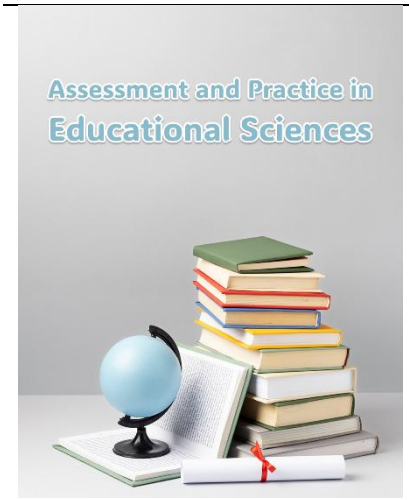

Strategies for Cultivating Self-Regulation Through Formative Assessment in Online Learning Environments

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ABSTRACT

This study aimed to explore and identify effective strategies for cultivating self-regulation through formative assessment in online learning environments. A qualitative research design was employed, utilizing semi-structured interviews to gather in-depth insights from 22 participants—including online instructors, instructional designers, and educational technology experts—from various higher education institutions in Tehran, Iran. Participants were selected purposively based on their experience with formative assessment in online teaching. Data collection continued until theoretical saturation was achieved. All interviews were audio-recorded, transcribed verbatim, and analyzed thematically using NVivo software to systematically identify recurring themes, subthemes, and concepts related to formative assessment and self-regulation. Three main themes emerged from the data: (1) formative assessment practices, (2) promotion of self-regulated learning, and (3) instructor roles and pedagogical beliefs. Key subcategories included goal clarification, timely and personalized feedback, scaffolded self-assessment tools, peer-assisted formative activities, time management facilitation, metacognitive prompting, motivational supports, and the use of learning analytics. Participants emphasized that transparent objectives, frequent individualized feedback, digital planners, and supportive instructor presence were central to fostering self-regulation. The findings highlighted the importance of intentional pedagogical design, active instructor engagement, and the integration of technology to scaffold each phase of the self-regulation process in online contexts. Formative assessment, when intentionally designed and supported by proactive instructional strategies, plays a pivotal role in cultivating self-regulation among online learners. The integration of clear objectives, personalized feedback, metacognitive supports, and a supportive online climate enhances learner autonomy, motivation, and academic success. These insights have significant implications for educators, instructional designers, and policymakers seeking to optimize formative assessment and self-regulated learning in digital education environments.

Keywords: Formative assessment; self-regulation; online learning; feedback; instructional design; qualitative research; higher education.

Introduction

The unprecedented expansion of online learning environments in higher education and professional development has catalyzed a transformative shift in the ways learners engage with instructional content, assessment, and self-directed learning processes (Hodges et al., 2020). This shift was particularly accelerated by the COVID-19 pandemic, which forced institutions worldwide to adopt remote and digital platforms at scale, fundamentally altering traditional pedagogical paradigms and necessitating new strategies to support learner success (Bao, 2020; Bozkurt & Sharma, 2020). Central to the effectiveness of online education is the capacity for learners to develop self-regulation skills—defined as the ability to manage one's own

learning through planning, monitoring, and reflecting on cognitive and motivational processes (Zimmerman, 2002; Panadero, 2017). In online contexts, where physical separation from instructors and peers can exacerbate challenges related to motivation, engagement, and accountability, fostering self-regulation has become a critical instructional priority (Broadbent & Poon, 2015; Kizilcec et al., 2017).

Formative assessment has emerged as a powerful pedagogical approach for supporting self-regulated learning (SRL) in both face-to-face and digital modalities. Rooted in the work of Black and Wiliam (1998), formative assessment refers to processes that provide ongoing feedback to both instructors and students with the aim of improving learning as it happens, rather than simply evaluating outcomes at the end of instruction. In online learning environments, the design and implementation of formative assessment require careful adaptation to ensure that feedback, goal setting, and self-reflection mechanisms remain robust and accessible (Gikandi et al., 2011). A growing body of research indicates that formative assessment strategies—such as timely, actionable feedback, scaffolded self-assessment tools, and opportunities for peer review—not only improve academic achievement but also enhance learners' capacity for self-regulation, enabling them to take greater responsibility for their own progress (Nicol & Macfarlane-Dick, 2006; Panadero et al., 2018).

Theoretical models of self-regulated learning, including those proposed by Zimmerman (2002) and Pintrich (2000), underscore the cyclical nature of SRL, involving forethought (goal setting and strategic planning), performance (self-monitoring and strategy use), and self-reflection (evaluation and adaptation). In the context of online learning, the absence of immediate social cues and structured routines makes it imperative for students to independently manage these phases, often with less direct oversight from instructors (Barnard-Brak et al., 2010). Consequently, formative assessment practices must be deliberately designed to scaffold each phase of the self-regulation process, helping learners to articulate goals, monitor their understanding, receive constructive feedback, and adjust their strategies accordingly (Clark, 2012; Panadero et al., 2017).

Multiple studies have demonstrated the unique challenges and opportunities associated with fostering self-regulation in online and blended environments. For example, Broadbent and Poon (2015) found that students' use of SRL strategies, such as time management and help-seeking, was strongly predictive of academic achievement in online courses. However, research also indicates that many learners struggle to sustain motivation, manage distractions, and monitor their progress without explicit instructional support (Kizilcec et al., 2017; Martin & Bolliger, 2018). The transition to remote learning has further highlighted disparities in self-regulatory capacity, with some students excelling while others become disengaged or overwhelmed (Pelikan et al., 2021). As such, educators are increasingly called upon to embed formative assessment practices that explicitly target and strengthen self-regulation, particularly through feedback, reflection, and metacognitive prompts (Nicol et al., 2014; Panadero et al., 2018).

The design of formative assessment in online environments must also account for the affordances and limitations of digital platforms. For instance, technologies such as learning management systems (LMS), discussion boards, and e-portfolios can facilitate real-time monitoring of learner engagement, enable rapid feedback delivery, and provide structured opportunities for self-assessment and peer interaction (Gikandi et al., 2011; Hattie & Timperley, 2007). Automated quizzes, interactive dashboards, and analytics-driven feedback loops offer scalable means to track student progress and intervene early when challenges arise (Ifenthaler et al., 2014). Nonetheless, research cautions that technology alone is insufficient; the pedagogical intentionality behind assessment design is paramount in ensuring that formative practices actually support SRL, rather than devolving into mere compliance or data collection exercises (Nicol et al., 2014; Shute & Kim, 2014).

Moreover, the instructor's role in cultivating a supportive online climate and modeling SRL behaviors is indispensable. Studies emphasize that instructor presence, timely communication, and explicit modeling of self-regulatory strategies can mediate the potential isolation and ambiguity inherent in digital learning spaces (Garrison et al., 2010; Martin & Bolliger,

2018). By fostering a learning community where students are encouraged to set goals, seek feedback, and reflect on their growth, instructors can create conditions conducive to both formative assessment and self-regulation (Shea et al., 2014; Jivet et al., 2020). Instructors also play a key part in adapting feedback to individual learner needs, promoting agency, and empowering students to take an active role in their own learning process (Nicol & Macfarlane-Dick, 2006).

Peer interaction and collaborative formative practices are increasingly recognized as significant contributors to SRL development in online settings. Research demonstrates that activities such as peer assessment, collaborative critique, and group reflection not only build academic skills but also enhance metacognitive awareness and accountability (Panadero et al., 2017; Strijbos & Sluijsmans, 2010). In asynchronous environments, these practices can mitigate the social distance often experienced in virtual classrooms, providing opportunities for learners to articulate their thinking, receive diverse feedback, and co-construct knowledge (Gikandi et al., 2011; Ertmer et al., 2007). Importantly, peer-led formative assessment encourages a culture of mutual support and shared responsibility, aligning closely with the core tenets of self-regulation (Panadero, 2017).

Despite the promise of formative assessment for enhancing self-regulation, there remain persistent challenges and unresolved questions. Research points to variability in students' receptivity to feedback, differences in digital literacy, and the risk of cognitive overload when assessment practices are not well integrated with course objectives (Ifenthaler et al., 2014; Jivet et al., 2020). Furthermore, instructors may require professional development and institutional support to effectively leverage technology, interpret learning analytics, and design assessments that meaningfully contribute to SRL (Martin & Bolliger, 2018; Shute & Kim, 2014). Understanding the complex interplay between assessment, learner agency, technological affordances, and pedagogical beliefs is therefore crucial for advancing both theory and practice in online education (Clark, 2012; Hattie & Timperley, 2007).

Given these considerations, there is a pressing need for empirical research that examines how formative assessment strategies are actually enacted in online learning environments, and how these strategies facilitate the cultivation of self-regulation among diverse learner populations. Qualitative studies that capture the perspectives of both instructors and students offer valuable insights into the lived experiences, perceived barriers, and effective practices that underpin successful SRL development (Panadero et al., 2018; Ertmer et al., 2007). By investigating the nuanced ways in which formative assessment is used to support self-regulation—through feedback, scaffolding, peer interaction, and technological tools—educators and instructional designers can develop more targeted, context-sensitive interventions that maximize the potential of online learning.

The present study addresses this gap by exploring the strategies used to cultivate self-regulation through formative assessment in online learning environments. Focusing on higher education instructors and educational experts in Tehran, this research draws on qualitative interviews to identify best practices, challenges, and recommendations for fostering SRL in digital contexts. In doing so, it aims to contribute to the growing body of scholarship on assessment for learning, offering actionable guidance for practitioners and policy makers seeking to enhance learner autonomy and achievement in the evolving landscape of online education.

Methods and Materials

Study Design and Participants

This study employed a qualitative research design to explore strategies for cultivating self-regulation through formative assessment in online learning environments. A phenomenological approach was adopted to capture the lived experiences and perspectives of individuals directly involved in online education settings. The participants consisted of 22 individuals, including

online instructors, instructional designers, and educational technology experts, all of whom were actively engaged in teaching or designing online courses in various higher education institutions located in Tehran, Iran.

Participants were purposefully selected based on their experience with formative assessment practices and their involvement in designing or delivering online learning modules. The selection process aimed to ensure a diversity of perspectives across disciplines, teaching styles, and institutional contexts. Theoretical saturation was used as the guiding principle for determining the sample size, and data collection was concluded once no new conceptual insights were emerging from subsequent interviews.

Data Collection

Data were collected through semi-structured interviews, which provided the flexibility to probe into participants' personal experiences while maintaining consistency across key thematic areas. An interview protocol was developed in alignment with the research objectives, focusing on aspects such as how formative assessment was implemented, perceived impacts on learner self-regulation, challenges faced, and successful strategies employed.

Each interview lasted between 45 and 75 minutes and was conducted either in person or via secure online video conferencing platforms, depending on participants' availability and preference. All interviews were audio-recorded with the consent of the participants and subsequently transcribed verbatim for analysis. Ethical considerations were observed throughout the process, including informed consent, confidentiality, and the voluntary nature of participation.

Data analysis

The transcribed interviews were analyzed using thematic analysis, facilitated by NVivo qualitative data analysis software. The analysis process followed Braun and Clarke's six-phase framework, which includes familiarization with the data, generation of initial codes, searching for themes, reviewing themes, defining and naming themes, and producing the report. An inductive coding approach was used to allow themes to emerge organically from the data rather than being imposed a priori.

Initial open coding generated a wide range of codes related to instructional practices, learner behaviors, assessment feedback, and motivational strategies. These codes were then organized into categories and refined into broader themes through axial coding. To enhance the trustworthiness of the findings, multiple strategies were employed, including peer debriefing, member checking with a subset of participants, and maintaining a detailed audit trail throughout the analytic process.

By adhering to rigorous qualitative research procedures and ensuring a deep engagement with the data, the study aimed to uncover rich, contextually grounded insights into how formative assessment strategies support the development of self-regulation among learners in online environments.

Findings and Results

Theme 1: Formative Assessment Practices

Goal-Clarification Strategies

Participants consistently highlighted the importance of clarifying learning objectives and success criteria at the outset of each module. Many instructors used transparent rubrics and provided weekly reminders to align student focus. One participant remarked, "When students see the learning goals clearly laid out, it reduces their anxiety and helps them understand what is expected." This approach included the regular articulation of objectives and explicit communication about assessment expectations.

Feedback Timing and Frequency

Timely and frequent feedback emerged as a crucial strategy. Immediate responses to student work, weekly progress updates, and the use of peer feedback loops helped maintain momentum and direction. As one instructor explained, “The quicker I can give feedback, the more motivated students are to revise and move forward.” Automated quiz results and regular check-ins also contributed to a dynamic and responsive learning environment.

Personalization of Feedback

Personalized, adaptive feedback was widely practiced. Instructors described tailoring comments to individual strengths and needs, providing targeted support and diagnostic insights. “Students appreciate it when the feedback is about their own work, not just generic comments,” noted a faculty member. This individualization encouraged deeper engagement and self-reflection.

Scaffolded Self-Assessment Tools

The use of self-assessment checklists, reflective prompts, and confidence scales supported students in evaluating their own progress. Rubrics for reflection helped learners structure their thoughts. One participant shared, “Asking students to rate their own work makes them pause and really think about what they did well and what they can improve.”

Use of Formative Quizzes

Low-stakes, formative quizzes were employed to encourage iterative improvement without the pressure of grades. Features such as progress visualization, retake opportunities, and immediate feedback promoted active engagement. A participant commented, “With these quizzes, students see where they stand instantly and can try again if they want to improve.”

Real-Time Monitoring Tools

Instructors used dashboards, live polls, and response analytics to monitor progress in real-time. Embedded tracking tools allowed for quick identification of students who might need extra support. One educator explained, “The dashboard helps me see which students are struggling before it’s too late to intervene.”

Peer-Assisted Formative Activities

Collaborative activities like discussion board feedback, breakout room reviews, and anonymous peer ratings were leveraged to foster peer learning. “Having students give each other feedback builds a sense of community and lets them learn from different perspectives,” observed a participant. This practice encouraged mutual support and accountability.

Theme 2: Promotion of Self-Regulated Learning

Time Management Facilitation

Digital planners, calendars, and time-on-task trackers were commonly used to help students manage their workload. Pacing guides and weekly schedules kept learners on track. One student said, “The calendar reminders are a lifesaver. Without them, I would probably forget half my deadlines.”

Metacognitive Prompting

Metacognitive strategies such as learning journals, self-questioning cues, and checklists were integrated into formative assessments. Instructors encouraged “think-aloud” modeling to demonstrate cognitive processes. “I ask my students to keep a journal about what strategies helped them learn, and it really makes them more aware of how they approach tasks,” noted one instructor.

Goal-Setting Supports

SMART goal templates, revision logs, and visual timelines helped students set, monitor, and adjust their learning objectives. Milestone markers made progress visible. As expressed by a participant, “Setting my own milestones makes big projects less overwhelming and helps me see how far I’ve come.”

Encouraging Task Engagement

Interactive modules, gamified progress tracking, and milestone badges incentivized ongoing engagement with learning tasks. Embedded challenges and opportunities for self-directed exploration further promoted active participation. “When I see my progress bar fill up, I want to keep going,” shared a student.

Emotional Regulation Supports

Encouraging messages, stress check-ins, and techniques such as self-talk and safe expression spaces were incorporated to support emotional self-regulation. “Sometimes a simple message from the instructor saying ‘You’re doing well’ really helps reduce stress,” commented a learner.

Motivation-Enhancing Feedback

Feedback that highlighted growth, effort, and incremental achievement was seen as especially motivating. Instructors emphasized a growth mindset and recognized progress. “When feedback points out how much I’ve improved, not just what’s wrong, it makes me want to keep trying,” explained a participant.

Theme 3: Instructor Roles and Pedagogical Beliefs

Instructor Presence and Support

Active instructor engagement—through prompt replies, facilitation, and regular announcements—contributed to a sense of presence and support. Open office hours and frequent check-ins reinforced availability. One participant remarked, “Even just knowing my instructor is there and responsive makes a huge difference.”

Beliefs About Learner Autonomy

Many instructors reported intentionally fostering autonomy by trusting students’ capacity to self-manage and minimizing micromanagement. “I believe students need some freedom to make mistakes and learn from them,” said one educator, emphasizing a shift from control to guidance.

Use of Data to Inform Feedback

Learning analytics were routinely reviewed to provide targeted feedback and personalized nudges. Monitoring progress trends enabled proactive intervention. “By checking analytics, I can spot who needs a push or a bit more support,” explained an instructor.

Assessment as Learning Philosophy

A learning-centered assessment philosophy prevailed among participants. They described formative assessment as non-punitive, reflective, and centered on growth rather than final outcomes. “I see assessment as part of the learning process, not just a way to grade students,” stated one faculty member.

Support for Student Agency

Empowering students through co-created rubrics, assignment choices, and flexible submission formats promoted agency and ownership. Soliciting student voice in feedback methods reinforced the value of learner participation. “Letting students have a say in how they’re assessed increases their investment in the work,” observed a participant.

Discussion and Conclusion

This study aimed to explore effective strategies for cultivating self-regulation among students in online learning environments through formative assessment. The findings revealed three overarching themes: (1) formative assessment practices, (2) promotion of self-regulated learning, and (3) instructor roles and pedagogical beliefs. Each theme encompassed multiple subcategories, highlighting the multifaceted and interdependent nature of assessment, student agency, and instructional design in fostering self-regulatory skills. In reporting these results, the present section also draws connections to the extant

literature, thereby situating the findings within broader scholarly debates on online education, formative assessment, and self-regulated learning.

The data indicated that clearly articulated goals, timely and individualized feedback, scaffolded self-assessment tools, and diverse formative assessment formats are central to supporting self-regulation in digital contexts. Instructors emphasized the importance of transparency in communicating learning objectives and assessment criteria, echoing previous research that has demonstrated the efficacy of goal clarification in reducing student anxiety and enhancing focus (Nicol & Macfarlane-Dick, 2006; Hattie & Timperley, 2007). Timely feedback—whether delivered via automated quizzes, progress dashboards, or direct instructor comments—was consistently valued by both instructors and students for its motivational and guiding effects. The importance of prompt, actionable feedback aligns with the "feedback loop" model described by Black and Wiliam (1998), as well as with more recent meta-analyses showing that formative assessment is most impactful when learners can quickly apply feedback to improve their performance (Panadero et al., 2018).

Personalization of feedback and the use of formative quizzes were further identified as critical to student engagement and progress. Instructors described adapting feedback to individual learner needs and leveraging low-stakes, iterative assessments to promote continuous improvement. These practices mirror findings from Gikandi et al. (2011), who reported that formative assessment in online settings is most effective when it is adaptable, personalized, and embedded within ongoing learning processes. The study also found that peer-assisted formative activities and real-time monitoring tools—such as live polls, analytics dashboards, and collaborative feedback—supported both individual reflection and community learning. The use of technology to facilitate formative assessment is widely supported in the literature (Ifenthaler et al., 2014; Jivet et al., 2020), but the results here reinforce that technological solutions must be paired with intentional pedagogical design to maximize their impact.

The findings highlighted that digital planners, metacognitive prompts, explicit goal-setting supports, and strategies for emotional regulation all play key roles in fostering self-regulated learning (SRL). Participants noted that the structure provided by time management tools and weekly schedules was instrumental in helping students maintain focus and balance competing demands—especially in the absence of traditional classroom routines. These observations align with research demonstrating that SRL strategies such as planning, time management, and self-monitoring are strong predictors of academic achievement in online learning (Broadbent & Poon, 2015; Barnard-Brak et al., 2010). The present findings also suggest that formative assessment can actively scaffold these skills, not only through feedback and reflection but also by encouraging proactive engagement and accountability.

Metacognitive prompting and goal-setting emerged as particularly significant. Instructors employed learning journals, self-questioning cues, and visual timelines to help students become more aware of their learning processes and track their progress. Such approaches echo Zimmerman's (2002) SRL model, which emphasizes the importance of forethought and reflection phases, and are further supported by research indicating that metacognitive scaffolding can enhance learners' ability to plan, monitor, and regulate their own learning (Panadero et al., 2017). Furthermore, motivational strategies—such as encouraging messages, growth-oriented feedback, and recognition of effort—were frequently used to sustain engagement, particularly in the face of the unique emotional and cognitive challenges posed by online education (Pelikan et al., 2021).

A recurring theme in the interviews was the vital role played by instructor presence and beliefs about student autonomy. Instructors who maintained an active presence—by providing timely replies, regular announcements, and open office hours—contributed to a supportive learning climate that fostered both engagement and agency. These results are consistent with the Community of Inquiry framework, which highlights instructor presence as a key factor in online learning success (Garrison et al., 2010). Importantly, participants also stressed the importance of believing in students' capacity for self-management,

minimizing micromanagement, and creating space for learners to make and learn from mistakes. This emphasis on learner autonomy echoes the shift in assessment philosophy described by Nicol et al. (2014), in which assessment is framed not as a punitive measure, but as an opportunity for growth and self-directed learning.

The use of learning analytics and data-driven feedback was another salient point, with instructors leveraging technology to provide targeted support and monitor student progress. The integration of assessment as learning—whereby students are empowered to co-create rubrics, select assignments, and participate in the feedback process—was also noted as a driver of student agency and investment (Panadero, 2017). Collectively, these practices reflect a broader pedagogical commitment to formative assessment as an enabler of SRL, rather than as an end in itself (Clark, 2012; Shute & Kim, 2014).

The findings of this study resonate strongly with prior research, which has consistently highlighted the interdependence between formative assessment and SRL in digital learning environments. For instance, Nicol and Macfarlane-Dick's (2006) principles of good feedback practice, which include clarifying goals, encouraging self-reflection, and delivering timely information, were reflected in participants' descriptions of their assessment strategies. The value of peer-assisted formative activities and collaborative feedback processes has been substantiated in studies by Panadero et al. (2017) and Strijbos and Sluijsmans (2010), both of which argue that peer interaction enhances metacognitive awareness and shared accountability.

The importance of motivational and emotional supports in online learning has been underscored by Pelikan et al. (2021), who found that students with higher self-regulation skills perceived themselves as more competent and less prone to procrastination during the pandemic-induced transition to online education. Similarly, the present study found that emotional regulation supports and motivational feedback were key to maintaining engagement and resilience. Furthermore, the use of technology for formative assessment—via analytics, dashboards, and automated feedback—has been widely promoted as a means to enhance feedback cycles and early intervention (Ifenthaler et al., 2014; Jivet et al., 2020).

Nevertheless, the study's results also reaffirm that technology cannot substitute for intentional pedagogy and relational instructor practices (Nicol et al., 2014; Gikandi et al., 2011). The need for ongoing professional development to support effective assessment design and interpretation of learning analytics is well-documented (Martin & Bolliger, 2018; Shute & Kim, 2014). Ultimately, the findings underscore that successful cultivation of self-regulation in online environments depends on a holistic integration of assessment, scaffolding, feedback, peer interaction, and a supportive learning climate.

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Authors' Contributions

All authors equally contributed to this study.

Declaration of Interest

The authors of this article declared no conflict of interest.

Ethical Considerations

All ethical principles were adheried in conducting and writing this article.

Transparency of Data

In accordance with the principles of transparency and open research, we declare that all data and materials used in this study are available upon request.

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