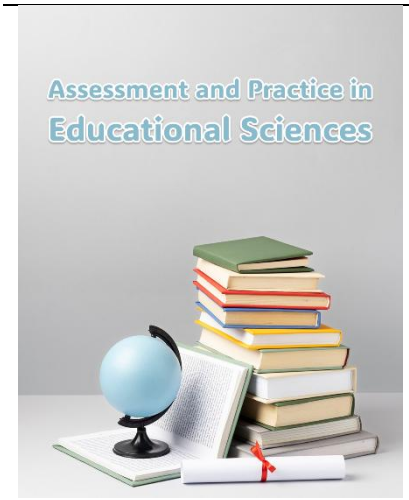
Assessment and Practice in Educational Sciences



Exploring Adaptive Feedback Strategies in Competency-Based Medical Education

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Article type:
Original Research

Article history:
Received 13 November 2023
Revised 15 December 2023
Accepted 26 December 2023
Published online 01 January 2024

How to cite this article:
Davoudi, S., & Eskandari, B. (2024). Exploring Adaptive Feedback Strategies in Competency-Based Medical Education. *Assessment and Practice in Educational Sciences, 2*(1), 1-9. https://doi.org/10.61838/japes.2.1.5

ABSTRACT

This study aimed to explore how clinical educators employ adaptive feedback strategies within the framework of competency-based medical education (CBME) to enhance learner development and performance. This qualitative study employed a phenomenological approach to investigate the experiences of clinical educators in CBME programs. Semi-structured interviews were conducted with 31 faculty members from various medical disciplines in Tehran, selected through purposive sampling. Data collection continued until theoretical saturation was achieved. All interviews were transcribed verbatim and analyzed using thematic analysis, following Braun and Clarke's six-phase framework. Nvivo software was used to facilitate data management and coding. The analysis focused on identifying patterns and strategies used by educators to tailor feedback in diverse clinical and educational contexts. Three main themes emerged: (1) Personalization of feedback, which included strategies such as emotional sensitivity, alignment with milestones, and tailoring feedback based on individual learner needs; (2) Contextual influences on feedback, which encompassed environmental constraints, institutional culture, and hierarchical dynamics that shaped feedback delivery; and (3) Developmental impact on learners, highlighting how adaptive feedback fostered motivation, self-regulation, and feedback-seeking behavior. Participants emphasized the importance of empathy, trust, and situational judgment in feedback practices, while also noting barriers such as time pressure and lack of formal feedback training. Adaptive feedback is a dynamic, context-sensitive process that plays a critical role in the success of CBME. Clinical educators utilize a range of strategies to tailor feedback based on learner characteristics, contextual demands, and developmental goals. Supporting these practices through institutional policy, faculty development, and cultural change is essential for fostering meaningful learning and competency progression in medical education.

Keywords: adaptive feedback; competency-based medical education; clinical teaching; qualitative research; formative assessment; feedback literacy; medical education

Introduction

In the evolving landscape of medical education, feedback has been consistently recognized as one of the most powerful tools for enhancing learning and performance. Within the framework of Competency-Based Medical Education (CBME), the importance of feedback becomes even more critical, given its centrality in guiding learners toward demonstrated proficiency across a continuum of competencies (Watling & Ginsburg, 2019). Unlike traditional educational paradigms, CBME emphasizes outcomes, individualized learning trajectories, and direct observation of performance, which in turn demand frequent, meaningful, and context-sensitive feedback (Frank et al., 2010). However, despite its significance, feedback often fails to achieve its intended impact due to misalignment with learners' needs, contextual barriers, or delivery methods that do not foster

engagement or growth (Sargeant et al., 2011). This has prompted a growing interest in adaptive feedback strategies—approaches that tailor feedback in real-time to suit learner characteristics, situational factors, and educational goals.

Feedback in medical education has traditionally been conceptualized through models that emphasize the unidirectional transmission of evaluative comments from teacher to learner (van de Ridder et al., 2008). However, the increasing shift toward learner-centered education necessitates a reimagining of feedback as a dialogic and dynamic process (Ajjawi & Boud, 2017). In CBME environments, where learners progress at individualized paces based on mastery rather than time, a one-size-fits-all approach to feedback is insufficient. Adaptive feedback, by contrast, accounts for the complexities of learner diversity, emotional readiness, prior knowledge, and contextual constraints, thereby increasing its effectiveness (Ramani et al., 2019). Research suggests that adaptive feedback supports metacognitive development, fosters self-regulation, and improves clinical reasoning by providing information that is relevant, timely, and framed in a supportive tone (Telio et al., 2015).

One of the key challenges in implementing effective feedback strategies in CBME stems from the variability in clinical environments. Clinical settings are inherently dynamic, marked by time pressures, unpredictability, and competing demands on both learners and supervisors (Molloy & Boud, 2013). In such contexts, feedback is often informal, unsystematic, and dependent on the disposition of the educator. Studies have shown that learners frequently perceive feedback as vague or overly critical, which diminishes its educational value and may hinder motivation (Harrison et al., 2013). Furthermore, feedback that does not consider the learner's emotional state or readiness can trigger defensive responses or disengagement, especially in hierarchical clinical cultures where learners may feel vulnerable (Watling et al., 2013). Adaptive feedback strategies are particularly valuable in such settings, as they emphasize not only the cognitive but also the affective aspects of learning interactions.

A growing body of literature highlights the role of feedback in promoting the development of self-regulated learning, particularly in competency-based systems. Self-regulated learners are characterized by their ability to set learning goals, monitor progress, seek feedback, and adjust strategies accordingly (Zimmerman, 2002). Feedback that is timely, specific, and tailored to the learner's current developmental stage can foster this capacity. For instance, Nicol and Macfarlane-Dick (2006) argue that feedback should not only inform learners of their performance but also guide them on how to improve, thereby bridging the gap between current and desired levels of competence. In CBME, where progression is individualized, such feedback must be attuned to specific competency milestones and entrustable professional activities (EPAs) to be meaningful (Ten Cate, 2013). Adaptive feedback strategies thus serve as both formative and summative tools, enabling learners to navigate the often nonlinear pathway to professional competence.

The conceptualization of feedback has also evolved to incorporate socio-cultural dimensions, recognizing that feedback is co-constructed within specific relational and institutional contexts. According to the feedback literacy framework proposed by Carless and Boud (2018), effective feedback requires not only the transmission of information but also the development of learner capacities to understand, process, and act upon that information. This view aligns with evidence that learners' responses to feedback are mediated by their beliefs, values, prior experiences, and the quality of the learner-teacher relationship (Bing-You et al., 2017). Adaptive feedback strategies, by emphasizing empathy, clarity, and responsiveness, align closely with this conceptual shift. They recognize that learners are not passive recipients but active agents in the feedback process.

Despite the theoretical recognition of adaptive feedback's value, empirical research in medical education has yet to fully articulate how such strategies are implemented in real-world CBME contexts. Much of the existing literature focuses on the structural features of feedback—such as frequency or modality—rather than its adaptiveness (Archer, 2010). Moreover, studies often overlook the perspectives of clinical educators who are at the frontline of delivering feedback within complex clinical ecosystems. There is a pressing need to explore how faculty navigate the challenges of time, institutional culture,

interprofessional dynamics, and emotional sensitivity when tailoring feedback. Understanding these processes is essential for informing faculty development initiatives and creating supportive infrastructures that enable adaptive feedback practices.

Additionally, while many studies have focused on feedback from the perspective of the learner, fewer have examined the strategies instructors themselves use to adapt their feedback approaches to different learner profiles and clinical scenarios (Ende, 1983; Bearman et al., 2010). Adaptive feedback is not only a pedagogical technique but also a form of professional judgment that requires nuanced understanding of learners' strengths, challenges, emotional cues, and learning goals. Faculty members must continuously make decisions about when, how, and what type of feedback to deliver—decisions that are influenced by factors such as familiarity with the learner, perceived receptivity, and institutional expectations (Govaerts et al., 2013). These tacit strategies remain under-explored and under-documented in the literature.

Given these gaps, this study aims to explore the adaptive feedback strategies employed by clinical educators within competency-based medical education programs. Specifically, it seeks to identify how feedback is personalized, how contextual factors influence its delivery, and what developmental impact it has on learners. Through in-depth qualitative analysis of clinical instructors' lived experiences, this research contributes to a more nuanced understanding of feedback as a dynamic, relational, and contextually embedded practice. The findings have implications for improving feedback literacy, guiding faculty development, and enhancing the overall quality of competency-based medical education.

Methods and Materials

Study Design and Participants

This study adopted a qualitative research design to explore adaptive feedback strategies employed in competency-based medical education (CBME). A phenomenological approach was used to capture participants' lived experiences and subjective interpretations of feedback processes within CBME contexts. Purposeful sampling was employed to recruit individuals with direct experience in medical education, including clinical instructors, educational supervisors, and faculty members affiliated with CBME programs in Tehran. A total of 31 participants (17 male and 14 female), representing diverse specialties and teaching roles, were interviewed. The sample size was determined by theoretical saturation, which was achieved when no new themes or insights emerged from subsequent interviews.

Data Collection

Data were collected through semi-structured interviews conducted over a span of four months. Each interview lasted approximately 45 to 75 minutes and was conducted in a private setting to ensure confidentiality and open dialogue. An interview protocol was developed based on existing literature and expert consultation, covering key topics such as types of feedback used, timing and mode of delivery, learner response, contextual influences, and perceived outcomes. Participants were encouraged to provide detailed narratives and examples from their educational practice. All interviews were audio-recorded with participants' informed consent and subsequently transcribed verbatim for analysis.

The process of data collection continued until theoretical saturation was reached—when no new themes or insights were emerging from subsequent interviews. Saturation was achieved after 30 interviews, suggesting sufficient depth and breadth of data to answer the research questions.

Data analysis

Thematic analysis was employed to analyze the interview data. Following Braun and Clarke's (2006) six-step framework, the researchers familiarized themselves with the data, generated initial codes, identified and reviewed themes, defined themes, and produced the final report. Nvivo qualitative data analysis software was used to manage, code, and organize the data. An inductive coding approach was adopted to allow themes to emerge naturally from the data rather than imposing preconceived categories. To enhance the credibility of the findings, investigator triangulation was employed: multiple researchers independently coded transcripts and met regularly to discuss interpretations and resolve discrepancies. Additionally, member checking was conducted by returning preliminary themes to selected participants for validation.

Findings and Results

Theme 1: Personalization of Feedback

Learner-Centered Tailoring emerged as a foundational subtheme, with participants consistently emphasizing the importance of adjusting feedback based on individual learners' progress, knowledge base, and goals. Instructors noted that "each student comes with a different trajectory of strengths and weaknesses," necessitating personalized responses. One faculty member shared, "For students who already master the basics, I push them to think clinically. For others, I slow down and reinforce fundamentals."

Emotional Sensitivity in Delivery was also vital. Faculty highlighted that the emotional state of learners influences how feedback is received. Empathetic communication was repeatedly mentioned as critical: "I try not to be blunt—even if the situation is urgent. If I can sense they're anxious, I choose my words carefully," said one participant. This sensitivity helps maintain learner motivation and openness.

Timing of Feedback was described as a practical yet strategic consideration. Participants spoke of varying their timing—some giving immediate, in-the-moment corrections, while others preferred to debrief after clinical rounds. "Sometimes it's better to let them reflect first. If I correct them in front of a patient, it shuts them down," one instructor explained.

Feedback Based on Progress Milestones was frequently cited in reference to CBME structures. Participants described aligning feedback with Entrustable Professional Activities (EPAs) and specific milestones: "When I see that a student is transitioning from observer to doer, that's when I give deeper feedback—more about judgment than knowledge."

Modality Preferences also played a role in how feedback was adapted. While verbal feedback was dominant, participants reported using digital tools and written notes to reinforce learning. "After the shift, I'll send them a short message summarizing strengths and areas to work on," one clinical educator shared.

Instructor Familiarity with Learner enhanced the depth of feedback. Longitudinal exposure to learners enabled instructors to provide more nuanced, cumulative insights. "When you've worked with a student over several weeks, you know what feedback will resonate," a senior faculty member noted.

Flexibility in Strategy Application was essential in dynamic clinical environments. Participants emphasized the need to shift strategies depending on learner needs and clinical demands. As one noted, "Sometimes a quick correction is enough; other times, I need to sit down and walk them through a scenario."

Theme 2: Contextual Influences on Feedback

Clinical Environment Constraints were a recurring theme, especially in high-pressure settings. Participants cited time limitations, heavy patient loads, and lack of privacy as barriers. "Sometimes I just don't have the luxury to give thoughtful feedback—I do it fast, or not at all," one resident supervisor admitted.

Interprofessional Dynamics influenced feedback in team-based learning environments. Feedback often came from nurses or allied health staff in addition to faculty. One educator reflected, “Sometimes the feedback from the nurse carries more weight for the student than mine, especially when it’s about teamwork.”

Institutional Culture and Norms shaped the overall climate of feedback. In some settings, feedback was normalized and expected; in others, it was sporadic and undervalued. “In our department, feedback is part of the culture—it happens organically. But in others, it’s seen as criticism,” explained one participant.

Hierarchical Relationships sometimes inhibited open dialogue. Learners were hesitant to question or seek clarification from senior faculty. “They’re afraid to look incompetent, so they just nod,” an attending reported. This power dynamic reduced the effectiveness of feedback.

Curriculum Structure in CBME played a facilitative role when feedback was embedded systematically. Educators appreciated built-in mechanisms like structured feedback sessions. “Having feedback checkpoints in the rotation really helps. It formalizes the process and ensures we don’t forget,” noted one clinical lead.

Feedback Policy Clarity varied widely. Some institutions had clear expectations for frequency and quality of feedback, while others left it to individual discretion. One participant complained, “We don’t get any training on giving feedback—it’s assumed we just know how to do it.”

Theme 3: Developmental Impact on Learners

Motivation and Self-Regulation was enhanced by constructive feedback. Participants observed increased learner engagement and goal-setting when feedback was actionable. “When they see they’re improving, they start asking for feedback themselves,” one clinical educator shared.

Feedback for Confidence Building helped learners develop a sense of competence. Positive reinforcement, even in small achievements, was shown to bolster confidence. “I always point out what they did right before mentioning mistakes. It keeps their morale high,” said one faculty member.

Cognitive Integration of Feedback was noted when learners could connect feedback to their knowledge base. Participants described this as “learning how to think,” rather than simply correcting errors. “When they apply yesterday’s feedback in today’s case, that’s when I know it clicked,” said a supervisor.

Learner Feedback-Seeking Behavior increased in supportive environments. Students were more proactive in requesting feedback when trust had been established. “One of my interns asked me, ‘What should I read to improve this diagnosis?’ That kind of question shows real growth,” an educator explained.

Emotional Responses to Feedback were diverse. While some learners expressed gratitude and motivation, others reacted with defensiveness or discouragement. “One student cried after I gave tough feedback. Later, she thanked me. It’s about timing and tone,” a participant noted, reflecting the emotional complexity of the process.

Discussion and Conclusion

This study sought to explore how clinical educators employ adaptive feedback strategies within the framework of competency-based medical education (CBME), using qualitative insights from 31 educators based in Tehran. The findings reveal that adaptive feedback is not only a pedagogical technique but also a form of situated judgment influenced by a complex interplay of learner characteristics, contextual constraints, and developmental goals. The three emergent themes—personalization of feedback, contextual influences, and developmental impact—offer a holistic view of how feedback is operationalized in CBME settings.

The theme of *personalization of feedback* highlights the educators' efforts to tailor feedback based on the learner's individual needs, emotional state, learning progress, and interpersonal rapport. This finding aligns with previous studies emphasizing the need for feedback to be specific, individualized, and emotionally attuned to be effective in clinical learning environments (Watling et al., 2013; Telio et al., 2015). By adjusting tone, content, and timing based on the learner's readiness and self-efficacy, educators foster a psychologically safe environment that encourages receptivity to feedback. The importance of emotional sensitivity, in particular, echoes the work of Ramani et al. (2019), who argue that emotionally intelligent feedback delivery enhances the educational alliance between instructors and learners, leading to better learning outcomes.

Educators in the study also reported aligning feedback with CBME milestones and Entrustable Professional Activities (EPAs), which reflects a strong integration of assessment and instruction. This is consistent with the CBME paradigm that advocates for feedback as a formative process directly linked to competency development (Frank et al., 2010; Ten Cate, 2013). Rather than offering generic comments, participants emphasized the need to contextualize feedback within the learners' trajectory toward independence, thereby transforming feedback into a scaffold for progressive learning. These practices support the notion that feedback should not only inform but also guide and motivate learners to achieve the next level of performance (Carless & Boud, 2018; Nicol & Macfarlane-Dick, 2006).

The subtheme of modality preferences further reinforces the adaptive nature of feedback delivery. Participants reported using verbal, written, and digital formats to match the learner's communication style and contextual constraints. This aligns with evidence suggesting that multimodal feedback increases retention and accessibility, especially when reinforced over time (Archer, 2010; Harrison et al., 2013). The use of follow-up messages and asynchronous feedback methods also indicates an expansion of traditional feedback boundaries, reflecting more continuous and learner-centered models of instruction.

The second major theme, *contextual influences on feedback*, underscores how institutional culture, clinical pressures, and hierarchical dynamics shape feedback practices. Many educators cited environmental constraints such as time scarcity, lack of privacy, and high patient volume as limiting their ability to provide in-depth feedback. These findings echo those of Molloy and Boud (2013), who note that workplace learning environments often hinder the formalization of feedback due to competing demands. However, adaptive strategies—such as brief, formative comments during workflow or delayed debriefs—demonstrate how educators creatively respond to these limitations. This suggests that adaptive feedback is not simply about customizing content but also about negotiating practical realities to maintain feedback integrity.

Hierarchical relationships emerged as a barrier to open feedback exchange. Several participants noted that learners hesitated to engage in feedback conversations due to fear of judgment or reprisal, especially when interacting with senior faculty. This resonates with previous research indicating that power differentials and credibility judgments significantly affect the feedback process (Watling & Ginsburg, 2019; Bing-You et al., 2017). When feedback is filtered through a hierarchical lens, it risks becoming a tool for control rather than a resource for growth. Addressing this challenge requires cultivating a feedback culture grounded in trust, psychological safety, and relational credibility (Ajjawi & Boud, 2017).

Participants also pointed to institutional ambiguity around feedback expectations and lack of faculty training as systemic barriers. While CBME emphasizes frequent and structured feedback, many institutions lack clear protocols or support mechanisms to ensure its consistent implementation. This discrepancy between policy and practice has been noted in previous studies that call for faculty development initiatives to enhance feedback literacy (Bearman et al., 2010; Govaerts et al., 2013). Our findings suggest that in the absence of institutional scaffolding, educators rely heavily on personal initiative and tacit knowledge to navigate the feedback process—an approach that is both variable and potentially inequitable.

The third theme, *developmental impact on learners*, illustrates how adaptive feedback promotes motivation, reflection, and cognitive integration. Participants described how well-delivered feedback encouraged learners to take ownership of their

learning, seek clarification, and connect feedback to clinical reasoning. These observations are supported by Zimmerman's (2002) model of self-regulated learning, which posits that learners who receive formative, constructive feedback are more likely to monitor their progress and adapt their strategies. Similarly, studies have shown that feedback delivered with attention to emotional well-being can improve learner confidence and reduce anxiety, thus promoting deeper learning (Telio et al., 2015; Sargeant et al., 2011).

A particularly novel contribution of this study is the identification of feedback-seeking behaviors as a product of adaptive instructional environments. Participants noted that learners in psychologically safe settings were more proactive in initiating feedback conversations and reflecting on their performance. This aligns with research by Carless and Boud (2018), who highlight the importance of developing feedback literacy not only in faculty but also in learners. When students are socialized to view feedback as a collaborative process rather than a judgmental event, they are more likely to engage with it constructively.

Taken together, these findings underscore the complexity and nuance of adaptive feedback in CBME. Effective feedback is not merely a function of content or frequency; it is a dynamic, context-sensitive, and relationally mediated process. Adaptive feedback requires faculty to exercise judgment, empathy, and pedagogical agility—skills that are rarely formalized in traditional faculty development programs. To fully realize the potential of CBME, institutions must prioritize the development of feedback cultures that support both educators and learners in this endeavor.

Acknowledgments

We would like to express our appreciation and gratitude to all those who helped us carrying out this study.

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.

Funding

This research was carried out independently with personal funding and without the financial support of any governmental or private institution or organization.

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