How can you deliver microlearning when learners don't want it? Designing microlearning for socially oriented learners

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ABSTRACT: What do you do when employees want sustained, in-person, dialogic learning opportunities, but the realities of their work prevent participation in such learning events? Microlearning can offer an important solution to this conundrum but also requires careful navigation between design recommendations, learner preferences, learning objectives tied to work tasks, and assessment. This concurrent mixed methods research study uses identical convenience sampling to answer the research question: How is employee learning impacted by microlearning design decisions made to address fundamental contradictions presented by learner preferences and workplace contexts? This study focuses on the case of microlearning lessons on inclusive teaching in a professional development program for faculty at a small comprehensive university in the southeastern United States. Eleven participants' reflections, contributions to asynchronous discussions, responses to a post-program survey, and submissions on pre- and post-lesson assessments were analyzed through qualitative coding and descriptive and inferential statistics. While quantitative data analysis revealed significant participant learning aligned with lesson objectives, qualitative analysis revealed that learners also engaged in learning beyond these learning objectives. Complementing extensive literature on microlearning for procedural learning, this study provides new insights related to needs assessment, suitable learning objectives, social dimensions, and assessment of microlearning and offers recommendations for designing and assessing microlearning when adapting it to learners' preferences and workplace contexts.

Keywords: Faculty development, Inclusive teaching, Instructional design, Microlearning, Peer learning

1. Introduction

What do you do when employees want sustained, in-person, dialogic learning opportunities, but the realities of their work prevent their participation in such traditional learning events? Microlearning offers an important solution to this conundrum. However, it also requires careful navigation between design recommendations, learner preferences, and the need for assessing learning. It may also require adroit handling of learning objectives centered on complex problem-solving tasks (Corbeil et al., 2021; Jahnke et al., 2020; Sozmen, 2022; Taylor & Hung, 2022; Zhang & West, 2020).

A case for examining these challenges was provided by a small comprehensive university in the southeastern United States when needs assessment prompted the design and development of a new professional development program on inclusive teaching for faculty. While inclusive teaching has typically been addressed through lengthy, dialogic, in-person training, challenges such as limited faculty time called for consideration of a microlearning intervention intended as standalone training (Taylor & Hung, 2022; Torgerson, 2021; Torgerson & Iannone, 2019). The design of 13 microlearning lessons, each lasting 3 to 10 minutes, was informed by local needs assessment, including learner analysis, and literature on microlearning design (Corbeil et al., 2021; Jahnke et al., 2020; Lee et al., 2021; Major & Calandrino, 2018; Zhang & West, 2020), with faculty preferences for socially oriented, in-person learning significantly shaping the eventual design. Studying this case provided an important opportunity to address the limited research on how instructional design for microlearning relates to learner preferences and learning.

To study this case, a concurrent triangulation mixed methods design with identical sampling was used to answer this research question: How is employee learning impacted by microlearning design decisions made to address fundamental contradictions presented by learner preferences and workplace contexts? Following a review of relevant literature, this article summarizes the context and methods used for this research study, presents the results of quantitative and qualitative analysis, and situates those results in relation to previous and future research and practices involving microlearning.

2. Literature review

Relevant existing literature on microlearning includes guidance on its design, assertions about its social potential, varied approaches to the assessment of learning gained through microlearning, modest research on learner preferences, and imbalanced attention to the use of microlearning in varied workplace contexts.

2.1. Design of microlearning

While microlearning design was found to be the second-most researched topic in literature on microlearning published between 2005 and 2021, much of that literature focuses on technologies rather than principles, models, or theories of instructional design. Key themes have included the use of best practices and technology, interactivity and game-based learning, social media, virtual reality and augmented reality, reduction of cognitive load, and design for learning outcomes in varied subject areas (Sankaranarayanan et al., 2023). In some cases, information processing theory (DeGagne et al., 2019; Dolasinski & Reynolds, 2020), theoretical models of learners (Baumgartner, 2013), and specific types of learning, such as scenario-based learning (Zulueta & Panoy, 2022), have been offered to suggest effective approaches to designing microlearning. However, this literature often lacks a detailed presentation of the design approaches, principles, or models used. Some authors have offered principles for microlearning that lack a clear basis in broader instructional design literature, such as the importance of format, focus, autonomy, structure, and simple access (Díaz Redondo et al., 2021). Others have noted how the rise of constructivism and the focus on microcontent have challenged traditional instructional design models, with Kerres (2007) bluntly asking "What happens to instructional design if we move below the unit of a lesson?" (p. 99).

Despite these trends, several authors of previous research and practitioner literature on microlearning have highlighted the importance of approaching microlearning through sound instructional design practices. As several scholars have stressed, it is essential to approach microlearning through purposeful design rather than simply dividing up content into small pieces (Corbeil et al., 2021; Zhang & West, 2020). This includes critical steps such as needs assessment and knowing the audience (Dolasinski & Reynolds, 2020; Hogle, 2021; Hutauruk et al., 2022; Margol, 2017). Other key design steps include writing behavior-based learning objectives that articulate isolated skills suitable to the scale of microlearning (Margol, 2017) and choosing suitable types of content (e.g., text, video, infographic) based on the skills to be developed and when they would be applied (Major & Calandrino, 2018; Margol, 2017). Several scholars have stressed the thoughtful application of Gagne's events of instruction within microlearning's durational constraints through emphasis on relevance, engagement, application, practice and application of content, and feedback, including applicability to mobile microlearning (Jahnke et al., 2020; Lee et al., 2021). Other design elements stressed for incorporation in microlearning have included activation of prior knowledge and contextualizing skills or problems "in real situations connected to learners' jobs and careers so that they can immediately apply the learning" (Zhang & West, 2020 p. 316). Regarding the development of microlearning designs, practitioner literature echoes research-based literature in stressing the importance of exploring non-text elements to create time-efficient learning opportunities and including concise assessments of learning (Arshavskiy, 2020; Margol, 2017).

2.2. Social potential of microlearning

Social connectedness has been cited as a driver of microlearning (Torgerson, 2021) and social media has often been proposed as a good partner for microlearning (Grevtseva et al., 2017; Kohnke, 2021; Tennyson & Smallheer, 2021). That partnership can range from distribution of microlearning videos through social media to the fostering of deeper learning and a sense of community among learners through digital tools that support collaborative microlearning (Kohnke, 2021; Palmon et al., 2021). Social media and social networks offer both benefits and challenges for microlearning (Heydari et al., 2019). For example, Palmon et al. (2021) stressed the value of social media (e.g., Twitter) for distributing medical education microlearning videos because it can overcome scheduling barriers and other challenges for reaching learners. In preparing teachers, digital tools can enable peer feedback on teaching plans shared within social networks (Kelleci et al., 2018). Social learning, peer learning, and peer feedback can be fostered by incorporating elements such as chat, online discussions, blogs, and practice exercises (Kohnke, 2021; Margol, 2017).

2.3. Assessment of learning in microlearning

All levels of Kirkpatrick's model of training evaluation can be applied to microlearning (De Gagne et al., 2019; Fennelly-Atkinson & Dyer, 2021). Level 2 evaluation, or assessment of learning, can be conducted through quizzes, tasks, self-assessments, and behavioral analysis; learning analytics have also been recommended and used to study microlearning (Fennelly-Atkinson & Dyer, 2021; Gross et al., 2019; Javorcik & Polasek, 2018). While some have suggested that social media can be used for assessment (Fennelly-Atkinson & Dyer, 2021; Kohnke, 2021), others have noted that social media can hinder assessment, specifically efforts to measure the educational benefits of microlearning videos distributed through Twitter (Palmon et al., 2021).

Despite these options for assessment, published research provides an imbalanced picture of microlearning's effectiveness. Publications on microlearning often do not attempt to measure learning directly, but rather learner response, preference, comfort, or confidence (Hegerius et al., 2020; Hesse et al., 2019; Heydari et al., 2019; Tennyson & Smallheer, 2021). Moreover, in their scoping review of literature on the effectiveness of microlearning, Taylor and Hung (2022) found a preponderance of research on the effects of microlearning in the medical and healthcare fields, with studies often measuring task performance proficiency and knowledge acquisition.

2.4. Learner preferences and microlearning

Efforts to note or address learner preferences involving microlearning have included research studies justifying the use of microlearning to address learner preferences among formats (e.g., elearning vs. microlearning) (Heydari et al., 2019; Javorcik & Polasek, 2018) and examining their preferences in interacting with videos in microlearning (Sung et al., 2023). However, there is limited evidence on how instructional design decisions made when developing microlearning in response to learner preference may impact learning. This article fills this void by addressing the intersection of instructional design, learner preferences, and assessment of learning within the microlearning format.

2.5. Workplace contexts

At the same time, this study addresses the disciplinary imbalance of empirical studies of microlearning to date. While microlearning has been promoted and adopted across many industries, scholarly literature reflects less industry diversity, with health professions and education being heavily represented. Hesse's et al. (2019) examination of microlearning in dairy farming illustrates a noteworthy exception to this imbalance. Taylor and Hung noted "an urgent need for more non-medical/healthcare empirical studies of microlearning to help enrich our understanding of this instructional approach," based on the unique nature of domain-specific knowledge, reasoning skills, and culture and the risk that studies of "a limited number of contexts may skew our understanding of its general effects as well as context-dependent effects on student learning" (Taylor & Hung, 2022, p. 27). This study addresses this gap by examining microlearning used to strengthen knowledge and skills in the domain of teaching in a non-medical higher education workplace context.

3. Context and methods

3.1. Context and participants

The microlearning faculty development program was designed, developed, and implemented at a small comprehensive university in the urban southeastern United States with approximately 130 full-time faculty and 170 part-time faculty. At this university, 32% of students are minority and 7% are international students; 15.3% of faculty are minority and 0.3% are international. Eleven faculty members participated in the research study and completed the faculty development program (Table 1 below). Of these, 9 identified as female, 2 identified as male, 1 identified as Asian, and 10 identified as white, 1 of whom also identified as Hispanic. Participants ranged in age from 28 to 70 years with a mean of 50 years. The participants included 3 part-time and 8 full-time faculty members. The author and study participants had previously interacted as colleagues through faculty orientations, workshops, and faculty development consultation services.

The microlearning program was run as self-paced learning during one month with program completion required for a modest stipend compensating faculty for their time beyond their standard contract period. The research

protocol was previously submitted to the university's Institutional Review Board (IRB), which determined that the project satisfied the federal regulatory criteria for exemption from further IRB review. Study participants represented a convenience sample of the university's faculty. After all faculty were invited to express interest in the program, 22 faculty entered the elearning app containing the program and consent form. Of those, 11 consented to participate in the research study and completed the program. Identical sampling was used with the same set of research participants providing both quantitative data and qualitative data.

Table 1. Participant demographics

Characteristic	Response	Number
Gender	Female	9
	Male	2
Race and ethnicity	White	10
	Asian	1
	Hispanic	1 (also identified as white)
Age	20–29	1
	30–39	1
	40–49	5
	50–59	2
	60–69	1
	70–79	1
Time base	Full-time	8
	Part-time	3

The author conducted the needs assessment, designed and developed the microlearning program, developed the data collection tools as integral parts of the program, and analyzed the data. The author's experience in the participants' organizational environment is consistent with Lee et al.'s assertion that "It is critical that researchers embed themselves into the learners' contexts and deeply understand the relationship among the media (digital technology) they use, the learning materials they engage with, and their real learning situations. They will then be able to develop a better learning solution" (Lee et al., 2021, p. 886).

3.2. Microlearning lessons

The self-paced program included 13 microlearning lessons delivered through Canvas, including its mobile app; this choice of technology (hereafter called "elearning app") enabled participants to complete lessons on a computer, tablet, or phone. Individual lessons delivered content about 5 to 10 minutes in length, except for the shorter concluding lesson. Needs assessment, literature review, and consideration of the local context and learners' preferences informed the program's design. First, survey responses from academic program leaders and a random sample of syllabi were analyzed to determine the need for developing faculty skills that support the success of a diverse student population. Skills identified for development related to assessments of learning, learning activities, and instructional climate and prompted a cognitivist approach to most elements of the program. Backwards design was identified as a useful framework for sequencing lessons; a short lesson was included to elucidate backwards design (Table 2 below).

Second, like other microlearning solutions that respond to challenges in workplace contexts (Lee et al., 2021; Palmon et al., 2021), microlearning was adopted to address common challenges in faculty development for inclusive teaching as noted in relevant literature. Faculty time, workload, scheduling conflicts, and program expenses have been reported as common obstacles to engaging faculty in such programming and scaling programming to reach all faculty at an institution (Guilbaud et al., 2021; Hsiao et al., 2019; Hudson, 2020; Wynants & Dennis, 2017). Microlearning is efficient and responsive to the scarcity of time and allows learners to complete learning experiences faster than other formats, such as regular elearning (Javorcik & Polasek, 2018; Leong et al., 2021; Torgerson, 2021). Figure 1 illustrates how lesson content presentation was limited in scope and presented in a practical format, such as steps supporting learner application. Figures 2 and 3 illustrate the mixture of concise verbiage, images, and videos used in lesson content in the computer and phone interfaces.

Table 2. Design of microlearning lessons

Lesson and focus	Learning objective	Duration of content	Knowledge check	Discussion	Application activities	Self-assessment
0. Orientation to program and	-	10 minutes	-	-	-	-

app						
1. What does inclusive teaching mean?	Explain what is encompassed by the phrase “inclusive teaching.”	5 minutes	-	Required	-	-
2. Evaluate one’s current teaching practices in relation to a diverse student population	Using the self-assessment tool, evaluate one’s current teaching practices to identify at least two major areas in which inclusive teaching techniques can be adopted to support all students.	10 minutes	-	-	Self-evaluation using Inclusive by Design worksheet	Yes
3. Pillars of inclusive teaching	Identify three pillars of inclusive teaching and specific instructional techniques that illustrate each	10 minutes	Yes	Optional	-	-
4. Using backward design to approach inclusive teaching	Explain the basic sequence of decision-making used in backward design, how it relates to the entire course preparation process, and how it impacts implementation of inclusive teaching techniques.	10 minutes	Yes	-	-	-
5. Transparency in assessments through descriptive rubrics	Given models, create an analytical rubric that provides students specific, descriptive feedback on their work based on at least three criteria that are aligned with course or module learning objectives and the letter grading system.	5 minutes	Yes	-	Create an analytical rubric	Yes
6. Increasing relevance and access through assessments that incorporate choice	Given models, construct an assessment of learning that gives students a choice between at least two questions or prompts and at least two submission formats while remaining consistent with learning objectives.	5 minutes	Yes	-	Create an assignment prompt that incorporates choice	Yes
7. Synthesis of skills developed in previous two	Using models, create a rubric for an assessment of	5 minutes	-	-	Create an analytical rubric for	Yes

lessons	learning that gives learners a choice of questions and a choice of submission formats, providing transparency about expectations and transparent feedback based on at least three criteria that are aligned with course or module learning objectives.				an assignment that incorporates choice	
8. Create inclusive learning experiences	Increase the inclusivity of learning experiences in one's courses.	10 minutes	-	Required	-	-
9. Plan for inclusive learning activities through discussion	Using models and a job aid, plan for a class discussion so that a diversity of perspectives is expressed and all students' sense of belonging is maintained, by using at least two preparation techniques.	5 minutes	-	Optional	Create a plan for an inclusive discussion	Yes
10. Moderate inclusive discussions as learning activities	Using models and a job aid, moderate a class discussion so that a diversity of perspectives is expressed and bias is interrupted, by using at least two facilitation techniques, and at least two techniques to interrupt bias and micro-aggressions.	5 minutes	-	Optional	Respond to a scenario	Yes
11. Interact with students using inclusive written and oral communication	Given models and a job aid, create more inclusive course documents exhibiting at least 5 techniques in the syllabus checklist.	5 minutes	-	-	Create or revise a syllabus	Yes
12. Interact with students using inclusive written and oral communication	Given models and a job aid, provide supportive, constructive written or oral feedback on student work, exhibiting at least 5 techniques in the feedback checklist.	5 minutes	-	Optional	Respond to a scenario	Yes
13. Final Self-Evaluation and Final Reflection	Using the self-assessment tool, evaluate one's	3 minutes	-	-	Self-evaluation using	Yes

	current teaching practices to identify at least two major areas in which inclusive teaching techniques can be adopted to support all students.	Inclusive by Design worksheet

Figure 1. Screenshot of teacher-designer view of items in Lesson 6

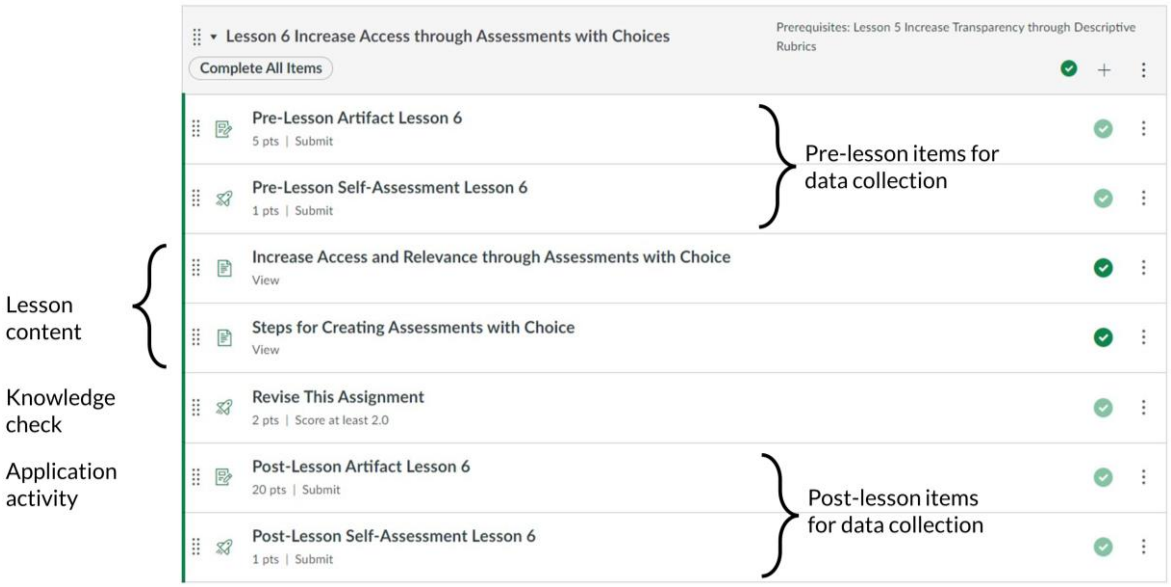
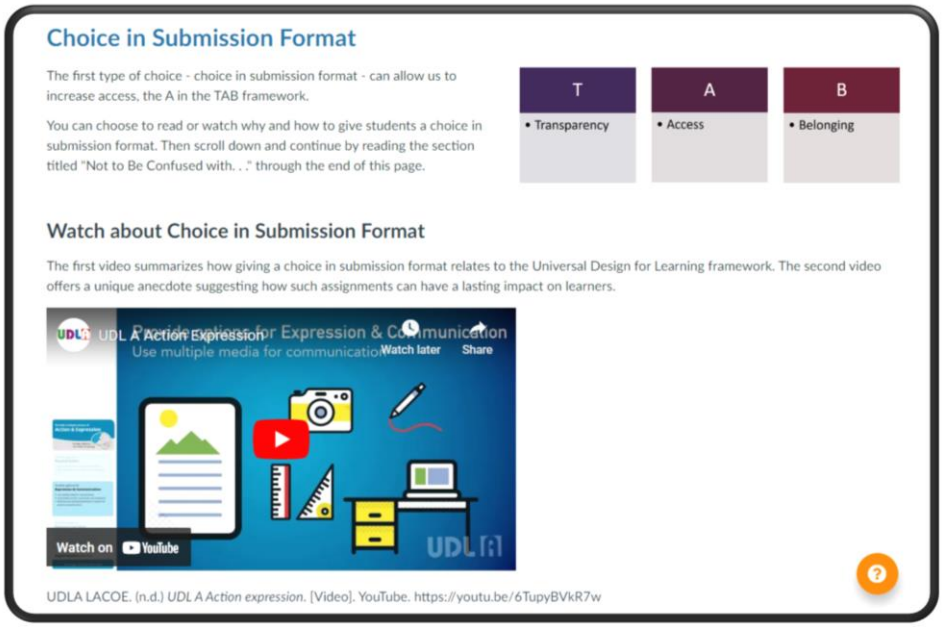


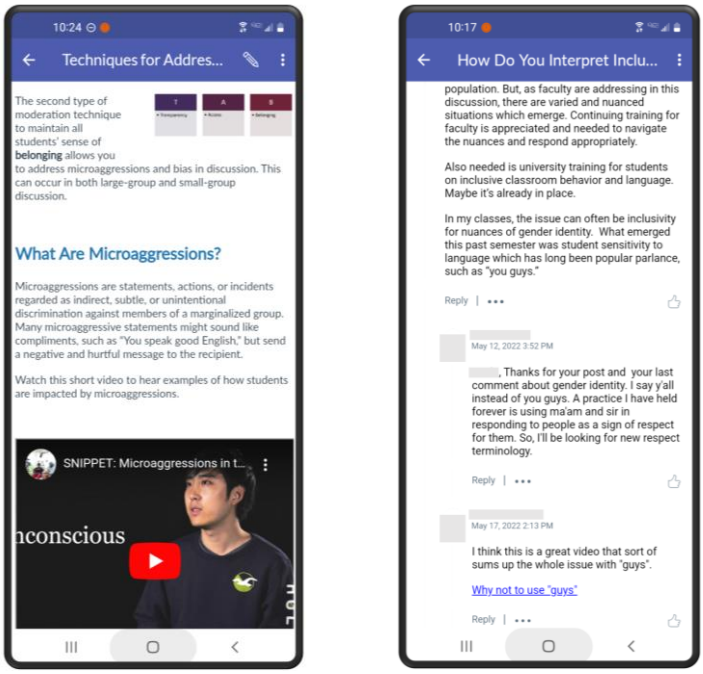
Figure 2. Screenshot of part of a content page in Lesson 6 in the computer interface



Third, learner preferences contradicting the time-constrained organizational context shaped the design of some microlearning lessons. Faculty at the university preferred in-person learning, synchronous learning, discussion-based formats, peer learning, and learning from faculty rather than staff or administrators. So even though faculty had insufficient time and often made limited use of these preferred formats, their preferences risked dissatisfaction with the cognitivist microlearning format identified as appropriate based on needs assessment. To address these challenges, six required and optional asynchronous discussions were added to the program design to support peer learning (Table 2 and Figure 3). Discussions were incorporated in ways that generated a wide range of lesson designs, including lessons with an artifact- or scenario-based application activity, a discussion,

both, or, neither. In lesson 8, learner choice among several specific skills was incorporated to address the varied prior knowledge of university faculty and support them as adult learners.

Figure 3. Screenshots of a content page in Lesson 10 and redacted discussion from Lesson 1 on the phone app



3.3. Data collection and analysis

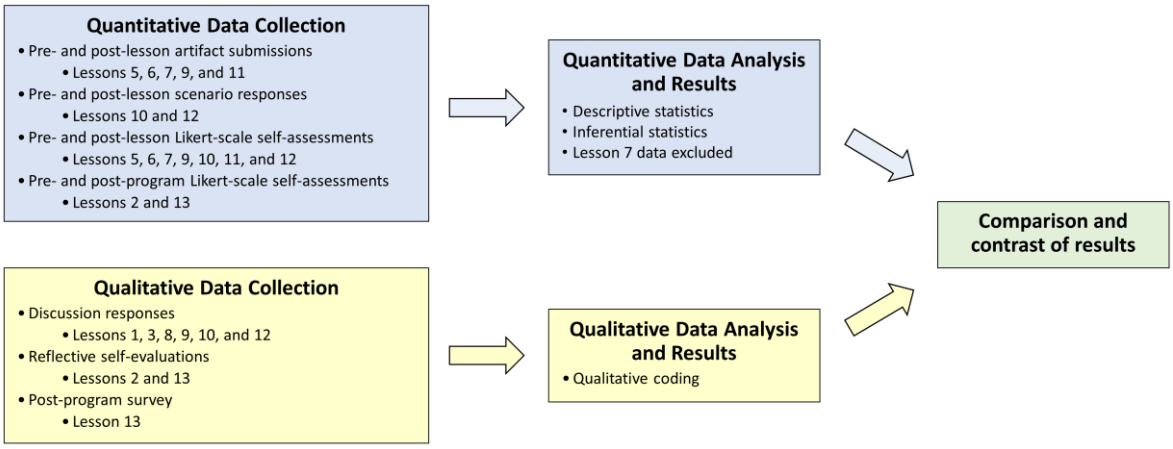
This study used a concurrent triangulation mixed methods design to answer this research question: How is employee learning impacted by microlearning design decisions made to address fundamental contradictions presented by learner preferences and workplace contexts? Both quantitative and qualitative data were collected through the elearning app and analyzed to strengthen validity and address limitations of each data type; data sources are listed in the 3 rightmost columns in Table 2. Prerequisites were set on content in the elearning app to ensure completion of learning assessments and activities used to collect data (Figure 1).

Distinct types of quantitative data were collected to measure the impact of individual lessons' design and the entire program on participants' learning. First, for the purposes of this study, seven lessons gathered both pre- and post-lesson data through the quantitative scoring of submitted artifacts and responses to scenarios that were included as application activities (see Application Activities column in Table 2, Figure 1, and Figure 4). Rubrics and checklists for this scoring were created during the program's design and development prior to participant recruitment; analytical rubrics were created to score artifacts submitted in lessons 5, 6, 7, 9, and 11, while checklists were used to score responses to scenarios in lessons 10 and 12. Second, nine lessons included a pre- and post-lesson self-assessment consisting of a Likert-scale question. At the beginning and end of seven lessons, the question asked participants to rate their ability level on the skill addressed in the lesson (i.e., 0 = no ability, 1 = basic ability, 2 = moderate ability, 3 = advanced ability, 4 = expert ability). In two lessons at the beginning and end of the program, the question asked participants to use the same scale to rate their ability to evaluate the inclusiveness of their teaching (Figure 4). Descriptive and inferential statistical analyses of pre- and post-lesson scores on artifacts, scenarios, and Likert-scale self-assessments were conducted to measure participant learning in individual lessons; both the paired sample *t*-test and Wilcoxon signed-rank test were used. Due to lesson 7 being unpublished at the beginning of the month, only 3 study participants completed it and data from this lesson were excluded from the analyses.

Qualitative data were collected to gauge participant learning, learning experiences, and perceptions of the design. Qualitative data were collected through participants' responses to open-ended questions in asynchronous discussions, reflective self-evaluations (Application Activities, Table 2), and a post-program survey. Responses were required for two discussions and optional for the other four (Discussion, Table 2). Inductive qualitative coding began with exploratory, eclectic coding and constant comparison using descriptive, in vivo, process, and concept codes in Taguette (Saldaña, 2021). Codes were compared with lesson design and analytical memos and categorization of codes were used to identify key patterns in the data. Results of the quantitative and qualitative

analyses were compared for corroboration, discordance, elaboration, and clarification (Creswell & Clark, 2007; Greene, 2007).

Figure 4. Data collection and analysis



4. Results

The results of quantitative and qualitative data analyses clarify how employee learning was impacted by microlearning design decisions made to address fundamental contradictions presented by learner preferences and the workplace context. While quantitative data analysis revealed significant participant learning aligned with lesson objectives, qualitative analysis revealed that learners also engaged in learning beyond those learning objectives due to design decisions made to accommodate learner preferences for discussion-based learning and learning from peers.

4.1. Quantitative results

Quantitative data analysis revealed increases in participants' mean post-lesson scores in two ways. First, participants' self-assessment scores increased in individual microlearning lessons and the entire program. Based on the difference between the means of the pre-lesson and post-lesson self-assessments, the participant group reported skill development in all lessons (Table 3 below). The greatest increases in self-assessment score means (0.9 to 1.0) occurred in lessons 5, 6, and 11, which focused on increasing transparency in instructor expectations by using descriptive analytical rubrics, assessments that give students choice among multiple prompts and multiple submission formats, and inclusive communication in course documents such as syllabi. Increases in self-assessment score means (0.5 to 0.7) also occurred in lessons 9, 10, and 12, which addressed planning for and moderating inclusive discussions to address microaggressions and bias and providing inclusive feedback on student work. A similar overall increase in self-assessment score means (0.7) resulted from the self-assessment question in lessons 2 and 13. Second, post-lesson scenario response and artifact score means increased when compared with pre-lesson means. These differences evidence skill development in all lessons (Table 3).

Table 3. Pre- and post-lesson self-assessment, artifact, and scenario score means

Lesson and focus		Self-assessment means			Artifact and scenario means		
		Pre	Post	Difference	Pre	Post	Difference
2	Self-evaluation of inclusive teaching practices	1.9	-	-	-	-	-
5	Transparency through descriptive rubrics	1.55	2.46	+0.91	3.23	9.77	+6.54
6	Assessments that incorporate choice	1.36	2.36	+1.0	2.27	5.18	+2.91
9	Plan for inclusive discussions	1.82	2.46	+0.64	0.82	5.64	+4.82
10	Moderate inclusive discussions	2.0	2.55	+0.55	5.18	5.27	+0.09
11	Inclusive communication in course documents	1.64	2.55	+0.91	1.82	5.27	+3.45
12	Inclusive feedback	1.91	2.46	+0.55	4.18	7.09	+2.91
13	Self-evaluation of inclusive teaching practices	-	2.64	+0.73	-	-	-

Due to the small sample size, a Shapiro–Wilk test was performed, and it showed that the distribution of artifact scores in lessons 5, 6, 9, and 11 did not depart significantly from normality, while the distribution of scenario scores from lessons 10 and 12 departed significantly from normality ($W = 0.72$, $p < 0.001$; and $W = 0.81$, $p =$

0.013, respectively). Based on this outcome, a parametric test (paired sample *t*-test) was used for scores from lessons 5, 6, 9, and 11 and a non-parametric test (Wilcoxon signed-rank test) was used for scores from lessons 10 and 12.

The participant group's scores on artifacts and scenarios submitted after lessons 5, 6, 9, and 11 were higher than those submitted before each lesson. Results of a paired sample *t*-test indicate that these improvements were statistically significant in all 4 lessons (Table 4). These differences were found to have a medium effect size (0.624 to 0.725). A pair of pre- and post-lesson artifacts created by the same participant in lesson 5 illustrates the differences in artifacts that generated these statically significant score increases (Appendix).

Table 4. Pre- and post-lesson artifact scores

Test scores	Mean	Standard deviation	Mean difference	*t*-test	*df*	*p* value
Lesson 5 Transparency through descriptive rubrics						
Pre-lesson	3.227	3.235	6.545	-6.409	10	< .001
Post-lesson	9.773	2.114				
Lesson 6 Assessments that incorporate choice						
Pre-lesson	2.273	1.191	2.909	-6.672	10	< .001
Post-lesson	5.182	0.982				
Lesson 9 Plan for inclusive discussions						
Pre-lesson	0.818	0.603	4.818	-5.663	10	< .001
Post-lesson	5.636	2.767				
Lesson 11 Inclusive communication in course documents						
Pre-lesson	1.818	0.982	3.455	-5.300	10	< .001
Post-lesson	5.273	1.679				

Scenario scores revealed that participants also demonstrated skill development in lesson 12 on providing inclusive feedback on students' work, but not in lesson 10 on moderating inclusive discussions. A Wilcoxon signed-rank test indicated that lesson 12 significantly improved participants' ability to provide inclusive feedback on student work (*Mdn* = 7) compared to their ability before the lesson (*Mdn* = 4), $z = -2.666$, $p = 0.008$ (Table 5).

Table 5. Pre- and post-lesson scenario scores

Test scores	Median	Standard deviation	Median difference	*z*	*df*	*p* value
Lesson 10 Moderate inclusive discussions						
Pre-lesson	5	0.874	0	-0.535	10	0.773
Post-lesson	5	0.647				
Lesson 12 Inclusive feedback						
Pre-lesson	4	1.250	3	-2.666	10	0.008
Post-lesson	7	1.814				

4.2. Qualitative results

Qualitative coding revealed how including discussions in microlearning lessons to accommodate faculty preferences for peer learning supported and evidenced participants' learning. Discussions did so by providing outlets for learning that went beyond the learning objectives identified through needs assessment, by prompting participants to make connections between ideas and experiences, and by providing a forum for participants to build on one another's ideas (see Table 6).

Table 6. Themes, categories, and sample codes in analysis of discussion responses

Theme	Category	Sample codes
Learning beyond the learning objectives	Reflection	Reevaluating past actions
		Questioning past actions
	Articulation of struggle and conflict	Addressing a struggle
		Expressing a contradiction
Making connections	Source-lesson connection	Connection to a text
		Connection to an image
	Experience-lesson connection	Connection to daily experience

		Connection to teaching
Building on one another's ideas	Contributing support	Adding evidence
		Posing a new question
	Extending peers' contributions	Offering a new interpretation
		Pushing exchange to a new level

4.2.1. Learning beyond the learning objectives

First, participants' discussion activities included reflection, questioning, and articulation of struggles and conflict that often went beyond the target learning objective. In several lessons, participants reflected on past teaching experiences and shared examples of ways they had furthered or hindered inclusivity. One participant reflected on and evaluated the limits of their previous understanding of inclusive teaching: "I think my focus though has been more with providing accommodations for students with learning differences. While in the back of my mind I was aware of additional barriers (working schedules and different cultures)." Some participants questioned and evaluated their past practices or expectations regarding inclusive teaching. For example, in lesson 1, a participant reflected on her response to a student who indicated having anxiety about public speaking and wanted to email her statements instead of contributing to a live discussion. As the participant explained,

> I said no, because an e-mail after the fact is fundamentally different, but instead I offered everyone in the class an option to participate via a live chat projected on the board. She still declined, and I gave zeros on those discussions. I may get criticism here for not being inclusive, and I don't know if I handled it the right way, but in my estimation I couldn't give as much as she wanted and she wouldn't accept anything else.

In lessons 1 and 3, several participants articulated struggles and conflicts, such as conflicts between providing students flexibility and maintaining academic standards, between aspiring to address all students' needs and feeling overwhelmed due to limited time and resources, and between wanting to cultivate a supportive tone when communicating with students and fearing students' perception of that tone as an invitation to take advantage of instructor flexibility in pursuit of reduced standards or accountability.

Through recurring reflection, questioning, and articulation of conflict, participants' discussion contributions provided evidence of learning that went beyond the learning objectives targeted based on needs assessment. Compared with the learning objectives shown in Table 2, several of these "learner-added" learning objectives were at higher cognitive levels (e.g., analyze) than the lesson objective (e.g., identify, explain). Examples of added learning objectives demonstrated by participants' discussion contributions included:

- Lesson 1: Analyze factors that have contributed to your disuse of inclusive teaching techniques
- Lesson 3: Analyze factors that can hinder implementation of teaching techniques that support the pillars of inclusive teaching
- Lesson 3: Propose solutions to risks and factors that hinder implementation of inclusive teaching techniques

Some participants' discussion contributions in lesson 3 illustrated analysis of factors hindering implementation of teaching techniques that support pillars of inclusive teaching, which were defined in the program as transparency, access, and belonging. Factors identified by participants included limited time, limited familiarity with various barriers faced by students, and the paradox of increasing barriers by reducing barriers. For example, one participant noted that if a $100 textbook were replaced with a free, open-source textbook, "students lose the electronic homework system which has built-in help tools; students like it, especially in online sections. For us, lowering barriers in one way comes at a cost of raising barriers in a different way."

In lesson 9, some participants engaged in deeper, critical reflection by evaluating past teaching techniques, experiences, and assumptions rather than simply planning for an inclusive class discussion by using specific preparation techniques as called for by the lesson's learning objective. Participants initially articulated their struggles in making a discussion inclusive when some students hold views that are not inclusive. After initially locating the problem with students, participants shifted their attention to their own impact on these discussions in their classes. They ultimately developed their evaluative reflections to the point that one participant, in a moment of deep insight, acknowledged that faculty who considered their attitudes and approaches to be inclusive could be framing topics in a biased and exclusive way that did not create the space for students with more conservative views to contribute.

4.2.2. Making connections

A second important way that discussions shaped and evidenced participants' learning was through their connecting ideas from varied sources, such as other readings, and from past experiences to achieve deeper learning. Participants made such connections in several lessons, including lesson 8, which focused on inclusive learning activities. Participants synthesized concepts from the lesson with observations and learning from daily experiences and previous professional development activities. For example, one participant connected content on digitally accessible materials to a recent email that she realized did not provide information in an accessible way. Another participant made a connection with the lesson's suggestion of creating a glossary to clarify language and symbols, a suggestion drawn from the principle of providing multiple means of representation in the Universal Design for Learning framework. The participant connected this concept from the lesson to a collaborative file creation activity she participated in during a previous professional development program. Synthesizing these ideas and experiences, she proposed having students collaboratively create the glossary in a cloud-based file. In this way, discussions evidenced and supported participants' synthesis of knowledge from multiple sources and experiences in ways more aligned with a constructivist view of learning than the cognitivist view that had driven much of the program's needs assessment-based design.

4.2.3. Building on one another's ideas

A third important element of learning fostered and illustrated by participants' discussion contributions was building on one another's ideas. While in some cases this involved contributing new evidence, in others this involved adding new interpretations. In Lesson 3, one participant (A) noted that transparency was more difficult to achieve than access or belonging because "How do we know what we don't know? I feel I'm always missing something, leaving something out. What are my unspoken assumptions?" Another participant (B) addressed and built on this observation by introducing metaphors related to time and space:

> How do we take our minds back to the state of a student, a time when we didn't know this material either? Material that, by now, we know well? How do we jump down into the hole with the student and show how to climb out?

Elaborating on the metaphor of discovery through space, participant B offered a possible solution to the challenge faculty face in identifying what is unknown to students:

> The idea of descriptive rubrics that communicate expectations sounds interesting. When students ask for a detailed rubric, I often read that as a signal that they're looking for a list of boxes to check. But maybe they're just looking for a map in unknown territory. Perhaps there's a way to create a rubric that encourages exploration of the territory, rather than just a list of mileages and highway numbers.

Participant A then built on this map metaphor to articulate how she could help students understand metaphor by using a rubric:

> Yes, "a map in unknown territory." That's one of the metaphors our textbook uses for discussing the transmission and transformation of folklore around the globe. Perhaps I could flip that and also use the map as a way of explaining the meaning of metaphor to some of [the] students with the development of a rubric that encourages viewing an assignment as a journey—a quest if you will.

A third and fourth participant (C and D) then noted how considering this discussion of metaphor helped them address their prior perception of rubrics as "boxes for students to check," a perception that they came to realize had been preventing them from using rubrics effectively. Participant C elaborated on the metaphor by asking how faculty could "provide the students a map/travel guide instead of a GPS?" Such exchanges illustrate how design decisions, particularly the inclusion of discussions, enabled participants to pursue learning beyond that conceived in the original learning objectives, which were largely based on a cognitivist view of learning, and engage in learning more aligned with a constructivist view.

4.3. Integration of qualitative and quantitative data

Qualitative post-program survey data can help interpret some of these quantitative results, including explaining unexpected results and clarifying learners' experiences when completing individual lessons. While quantitative analysis showed that significant learning occurred in lesson 5 focused on rubrics, qualitative analysis of post-

program survey data revealed that six participants identified this as the hardest lesson to complete. When explaining this, participants noted their dislike of the content, resistance to or questioning of the content due to colleagues' views, lack of confidence, and lack of prior experience. Participants' explanations point to a possible design flaw of not sufficiently addressing learners' preexisting opinions and attitudes when designing individual lessons. Survey data also help explain the lack of significant score increase for scenarios in lesson 10 on facilitating inclusive discussions. While many participants exhibited strong skills in their pre-lesson scenario responses and used similar techniques in their post-lesson scenario responses, one participant identified it as a confusing lesson, citing cognitive overload and the fact that the "topic made it harder to have a concrete guideline." The cognitive overload was likely fueled by the lesson's reliance, unlike other lessons, on externally created pre-existing resources rather than information distilled from them into one elearning app page tightly aligned with the lesson's focus. In addition, the topic required context-dependent use of skills, making it challenging to articulate guidelines with the clarity possible for other topics.

Conversely, quantitative data helps clarify the possible impact of design decisions on participants' learning. The addition of asynchronous discussions revealed that some participants' learning extended beyond the planned lesson learning objectives; a possible consequence was that their attention was diverted from those objectives. As seen in lesson 9, however, the participant group demonstrated strong skill development based on comparison of scores on pre- and post-lesson artifacts even as some participants also engaged in more complex learning as evidenced in their asynchronous discussion. The lessons that contained both artifacts or scenarios assessing participants' progress on lesson learning objectives and asynchronous discussions that could have prompted and documented learning beyond those learning objectives—lessons 9, 10, and 12—generated varied score increases on pre- and post-lesson artifact and scenario scores, ranging from negligible to statistically significant increases. This suggests that other factors—such as using decontextualized, short scenarios to assess participants' learning—may have contributed to those varied results.

5. Discussion

Consideration of both quantitative and qualitative results helps answer the fundamental question: How is employee learning impacted by microlearning design decisions made to address fundamental contradictions presented by learner preferences and workplace contexts? Based on these results, the combination of adherence to fundamental instructional design principles resulting in decisions to use a primarily cognitivist framework and accommodation of learner preferences by providing complementary outlets for topical social interaction enabled learners to achieve the intended learning objectives identified through needs assessment while also allowing them to achieve higher order learning in ways consistent with social constructivism. Insufficiently focused learning materials and insufficiently realistic scenarios, rather the diversion of attention to social interaction, appear to have contributed to some lessons producing less learning than others. These results also add important findings to literature on microlearning, highlight several important design considerations, and support specific design recommendations.

5.1. Social potential of microlearning

First, this study enriches our understanding of the social potential of microlearning and reinforces its importance. While several previous studies have stressed the value of social media for distributing microlearning, particularly in video format, this study has clarified how microlearning can support collaborative, socially constructed learning as urged by Kohnke (2021) and Göschlberger (2017). Participants' questioning and building on one another's ideas to generate new knowledge is best understood from the perspective of social constructivism and occurred despite a design shaped primarily by a cognitivist perspective. This suggests the value of intentionally designing microlearning to support collaboration and socially constructed knowledge where appropriate based on needs assessment.

5.2. Learners' preferences, prior knowledge, beliefs, and attitudes

This study confirms the importance of conducting needs assessment when designing learning (Wang et al., 2010). It demonstrates the impacts of using needs assessment not simply to inform the use of microlearning instead of a more traditional delivery format, but rather to inform the design of microlearning lessons themselves. Learner analysis and analysis of the learning context, including the organizational workplace setting, are important for informing a microlearning design that accounts for and is responsive to learner characteristics

and preferences as well as contextual factors that can constrain or enable learning. Reflecting learning design decisions based on learner and context analysis, discussion opportunities not only supported deep learning but also elicited positive participant feedback in the post-program survey. In addition to participants' citing the microlearning's useful, well-organized content being "packed" into a concise and schedule-friendly format, three participants specifically cited opportunities for peer input or discussion as factors that would prompt them to use microlearning again. This feedback is even more significant given the strong faculty preference for in-person learning before the COVID-19 pandemic and ongoing interest in returning to in-person learning after its peak.

Moreover, findings from qualitative analysis suggest that an important distinction be made between learners' willingness to engage in or "adopt" microlearning and their adoption of the content and behavioral changes targeted through microlearning (Puah et al., 2022). As illustrated through participants' explanations of how their own beliefs and peers' beliefs impacted their reactions to content of the microlearning program, learners' integration of new knowledge and willingness to adopt new skills are impacted by prior knowledge and attitudes about the subject matter. Despite design alterations made to accommodate faculty preference for social learning opportunities in the structure of microlearning program as a whole, post-program survey responses clarified that more attention was needed to learners' possible attitudes, opinions, and beliefs about specific content. This suggests the importance of approaching microlearning lesson design with attention to ways that learners can incorporate new and prior knowledge, reflect on prior knowledge, and revise their own individual understandings (Simons & Crawford, 2021).

5.3. Types of learning objectives

Results indicate that microlearning promoted participants' learning at the cognitive levels of creation, analysis, and application, reflecting both planned learning objectives and learners' engagement in deeper learning. This contrasts with some prominent guidance on microlearning. Microlearning has been identified as good for "teaching dense, fact-based content" (Hogle, 2021, p. 143), and those who have focused on mobile microlearning have deemed it suitable for lower-level cognitive learning objectives and topics "that are easy to learn, and that have a correct answer available" (Jahnke et al., 2020, p. 611). Microlearning has been used extensively for procedural learning objectives, such as surgical technique (Hesse et al., 2019; Ichiuji et al., 2022; Palmon, 2021; Taylor & Hung, 2022; Wakam et al., 2022), while being deemed inappropriate for complex processes, complex skills, or activities that require sequencing and balancing many behaviors (Fennelly-Atkinson & Dyer, 2021; Margol, 2017). Despite this emphasis in previous literature, the present study suggests that microlearning, including microlearning that can be used on mobile devices, can support learners' achievement of higher cognitive-level learning objectives and application of complex problem-solving skills. This mixed methods study has provided more robust and detailed findings that support Göschlberger's (2017) assertions, based on Baumgartner's (2013) three-level model of learning, that social interaction in microlearning can help learners move from lower-level cognitive objectives to higher-level cognitive objectives, including critical analysis and reflection.

5.4. Assessment design in microlearning design

The interplay of design decisions and evidence of participant learning also offers important insights for assessing learning in microlearning. The inclusion of varied ways for participants to demonstrate their learning revealed the potential limitations of certain types of assessments in microlearning. Closed-ended questions and scenarios with limited response options may offer concise ways of assessing learning within durational parameters commonly associated with microlearning (Arshavskiy, 2020; Margol, 2017). They may also offer the convenience of quickly determining scores. However, they may not reveal the breadth and depth of learning supported by a microlearning program. An irony of the design process that shaped the microlearning program in this study is that the discussions that revealed participants' deeper learning would not have been included if not for concern about faculty frustration and disappointment with a program that lacked opportunities for social interaction. The program's original conception emphasized short self-assessment questions and realistic work samples that could measure participants' progress on lesson learning objectives. However, in some lessons, it was only because of design changes to accommodate learner preferences that deeper learning was evidenced. This suggests that designers consider providing varied ways for learners to demonstrate their learning; even if some activities or assessments are not required for program completion, they can still provide valuable insights about the potential of a microlearning program to support development of skills or knowledge that the designer may not have anticipated. Thus, microlearning design should involve careful attention to the design of assessments of learning in addition to the design of content.

6. Limitations and future research

This study has several limitations, including the small number of participants, author's fulfillment of multiple roles, and possibility of self-selection bias. Participants may have had greater appreciation for or openness to inclusive teaching and may not have been fully representative of the university's faculty. As participants came from only one type of university, results may not be representative of higher education faculty more generally, such as faculty who work in research universities or have primarily graduate-level teaching responsibilities.

Despite these limitations, this study suggests important directions for future research related to the pedagogical and evaluation dimensions of Khan's elearning framework as adapted for microlearning (Corbeil et al., 2021). First, the social component of microlearning should be examined further with respect to its impact on learning. In particular, extending the work of Göschlberger (2017), further research should be conducted to test how social interaction in microlearning may assist learners in moving between Baumgartner's (2013) three levels of learning: absorption, acquisition, and construction of knowledge, which Baumgartner relates to behaviorism, cognitivism, and constructivism, respectively. Second, more research should be conducted to clarify the types of learning objectives that can be effectively addressed through microlearning, and under what design, delivery, and social conditions. While existing frameworks articulate several dimensions of microlearning, learning objectives have been overlooked in favor of dimensions such as target group, learner's role and participation, time spent, and content type, creation, aggregation, and retrieval (Buchem & Hamelmann, 2010; De Gagne et al., 2019).

Finally, future research may address challenges of assessing learning, particularly learning of complex skills, in microlearning. While assessment of work samples was incorporated in this study, it may have increased the time some participants spent on program activities beyond common durational definitions of microlearning. Assessment of learning (as opposed to learner perceptions and reaction) may impact the nature, duration, and experience of microlearning (Fennelly-Atkinson & Dyer, 2021). Conversely, assessing learning from microlearning may be challenging when that learning continues through application activities involving real workplace tasks. For these reasons, additional mixed methods research may be especially helpful in providing further insight on the assessment of learning through microlearning, the social component of microlearning, and their relationship to principles of instructional design, including suitable learning objectives.

7. Conclusion

This examination of how microlearning can be designed to promote learning in challenging workplace circumstances while also responding to learners' contradictory preferences highlights how designing and assessing microlearning are just as complex as for other formats of learning. Fundamentally, delivering successful microlearning for learners who do not want it hinges on basic principles of instructional design, including needs assessment, learner analysis, and adaptation to learner and contextual characteristics. In the case studied, the combination of adherence to fundamental instructional design principles resulting in decisions to use a primarily cognitivist framework and accommodation of learner preferences by providing complementary outlets for topical social interaction enabled learners to achieve the intended learning objectives identified through needs assessment while also allowing them to achieve higher order learning in ways consistent with social constructivism. This combination of approaches also resulted in positive learner feedback that both stressed the useful, well-organized content being "packed" into a concise and schedule-friendly format and noted the opportunities for peer input or discussion as factors that would prompt them to use microlearning again. This study suggests the value of intentionally designing microlearning to support collaboration and socially constructed knowledge where appropriate based on needs assessment.

Studying this case has addressed key gaps in the literature on microlearning. First, it has contributed a close study of the impact of design decisions on learning, learner experience, and assessment of learning in a way that illustrates the continued relevance of instructional design principles for microlearning amid literature that often emphasizes relevant technologies and has questioned the value of instructional design. Second, it has responded to the call for more research on microlearning in varied non-medical contexts.

This case study also highlighted several more specific takeaways relevant to existing and future research on microlearning. This study confirmed the importance of conducting needs assessment when designing learning (Wang et al., 2010) and not simply to inform whether microlearning is used, but rather how it is used. It also exposed the importance of attending to learners' possible attitudes, opinions, and beliefs about specific content and approaching microlearning lesson design with attention to ways that learners can incorporate new and prior knowledge, reflect on prior knowledge, and revise their own individual understandings (Simons & Crawford,

2021). It suggests that microlearning, including microlearning that can be used on mobile devices, can support learners' achievement of higher cognitive-level learning objectives and application of complex problem-solving skills. It supports Göschlberger's (2017) assertions, based on Baumgartner's (2013) three-level model of learning, that social interaction in microlearning can help learners move from lower-level cognitive objectives to higher-level cognitive objectives, including critical analysis and reflection. At the same time, this study called attention to the possibility that concise assessments of learning well suited to microlearning's chronological scale (Arshavskiy, 2020; Margol, 2017) may not reveal the breadth and depth of learning supported by a microlearning program, highlighting the need for more careful attention to the design of assessments of learning, rather than simply design of content, in microlearning.

As analysis of participants' work samples, self-assessments, discussions, and survey responses shows, effective microlearning requires adroit handling of learning objectives and careful navigation between common design recommendations, learner preferences, and the need for assessing learning. Not limited to short chunks of content that can be conveniently distributed through social media channels to help learners gain procedural skills, microlearning informed by sound application of instructional design principles can provide rich opportunities for learners both to build high-level cognitive skills and to engage with peers in the social construction of knowledge.

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Appendix

Lesson 5 pre-lesson artifact

One participant's artifact submitted prior to lesson 5 included the following explanation of grading. To maintain participant anonymity, selected words have been redacted:

You will get a "check" for showing that you have the ability/skill to execute a specific [adjective] experience. A "check" earned on the first attempt is worth at least a 9 out of 10 points. Scores of 9.2, 9.5, 9.8 may be earned if you demonstrate mastery of the specific skill and/or demonstrate a high level of creativity. Perfect scores of 10 out of 10 will seldom be given out just because I don't see this demonstration like a math test where there are absolute right or wrong answers. You will have 2 opportunities to redo your demonstration with me privately if you do not get a "check" the first time. If you receive a check on a second or third attempt, you will receive a score of 8. You will receive a 5 if the specific skill is not demonstrated after 2 re-dos.

Lesson 5 post-lesson artifact

The same participant's revision submitted at the end of lesson 5 included this analytical rubric. To maintain participant anonymity, selected words have been redacted:

Criteria	Mastering (10)	Proficient (9)	Developing (try again)
Planning	Demonstrate the proficient level work and show originality and/or creativity such as creating original [noun].	Each element of the application is presented with accuracy and clarity.	Any of the element of the application is missing and/or needing revisions.
Implementing	Execute step-by-step procedures as written in the application plan with a smooth flow and appropriate pace.	Execute step-by-step procedures as written in the application plan including [noun].	Skip some steps of the procedure or out of order. [Noun] is not presented as planned, including [specific skill not demonstrated], [specific skill not demonstrated], etc.
Facilitating	Respond in the moment to unexpected scenarios with spontaneous adaptations and/or extensions.	Demonstrate appropriate facilitating skills including eye contact, proximity, reinforcement, cueing, and prompting. Apply planned adaptation and/or extension in respond to unexpected scenarios.	Any of the facilitating skills that need more practice and improvement. Not able to respond to unexpected scenarios with planned adaptation and/or extension.
Evaluating	Identify 1 strength and 1 area of growth in the peers' demonstrations and provide constructive feedback/action plans for improvement.	Identify 1 strength and 1 area of growth in the peers' demonstrations.	Provide feedback but the feedback does not reflect the strengths and/or areas of growth in the peers' demonstrations.