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ORIGINAL PAPER

How Does Macrolearning Contribute to Self-Efficacy?

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Abstract
Microlearning is gaining ground in the higher education domain. Despite this trend, there is a lack of evidence of effectiveness when a large number of microlearning units are grouped to form a macrolearning programme. The purpose of this paper is to explore how and why a macrolearning affects students' self-efficacy. The originality of this paper is its in-depth analysis of an EdTech startup named MLMaster, which has built a portfolio of several business programmes, each consisting of over one hundred microlearning units, forming macrolearning programmes. The main contribution of this paper is to uncover critical insights into how self-efficacy is built in practice, driven by two main factors: participants' affective states, which are the positive feelings after taking part in the programme, and mastery experiences, which is the application of learning at work.

Keywords Higher education · Macrolearning · Microlearning · Self-efficacy

Introduction

Students nowadays use microlearning in a natural and habitual way to resolve all kinds of issues and meet daily needs, showing a preference for consuming educational content in short videos via mobile phones, pulling the knowledge and information they need when they need it (Hamilton et al., 2021; Taylor & Hung, 2022). Microlearning is defined as learning in small steps, supported by short blocks of content and activities (Sun et al., 2018) and focused on delivering skill-based and just-in-time knowledge (Paul, 2016), commonly by means of 5- to 10-min lessons (Taylor & Hung, 2022). The accumulation of a significant number of microlearning lessons is qualified as a *macrolearning* programme (Zhang & West, 2020).

Higher education institutions have also experienced microlearning positively, showing promising results in different disciplines such as soft skill teaching (Romanenko et al., 2023), and increased student self-reported knowledge and reasoning skills development after completing a microlearning module on hospitality training (Dolasinski & Reynolds, 2023). While acceptance of microlearning effectiveness for skill-based training has been established, its very nature as a short-form content constrains microlearning units to small and discrete topics for informational or conceptual learning (e.g., *What is a Business Model Canvas?*). In this respect, some argue that the characteristics of microlearning prevent this methodology from being effective for more integral or systemic topics (Taylor & Hung, 2022), thereby questioning the learning effectiveness of microlearning.

New entrants outside of traditional higher education institutions have also entered the microlearning sphere, including the EdTech player explored in this article, which offers an attractive new learning value proposition that is reaching thousands of participants and is based on grouping more than one hundred microlearning units. Some authors have argued the importance of designing macrolearnings with a visual progress display (Baumgartner, 2013; Winger, 2018) to prevent students from becoming overwhelmed by the large number of bite-size lessons (Zhang & West, 2020). However, to the author's knowledge, the effectiveness of macrolearning remains unexplored, resulting in calls for exploration of its capacity to develop less tangible knowledge, and whether grouping a significant number of microlearning units or micro lessons can help the participant to develop complex competencies (e.g., *How can I be an entrepreneur?*) (Zhang & West, 2020), especially given the concern about the effectiveness

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of short microlearning lessons when dealing with topics that require in-depth reasoning or comprehension (Taylor & Hung, 2022). If perceived by students as effective in developing abilities of a certain complexity, these learnings would open a window of opportunity for higher education institutions, because as a highly scalable educational strategy macrolearning overcomes the time, cost and quality restrictions that have historically constrained higher education institutions' public service capacity.

The self-efficacy theory (Bandura, 1977) is used as the theoretical foundation to understand macrolearning effectiveness and to know the role of the main sources of self-efficacy in this learning, namely affective states, vicarious learning, mastery experiences and social persuasion. Self-efficacy is considered decisive for academic performance (Van Dinther et al., 2011), and has been studied extensively in the context of higher education. Different research findings state the positive effect of microlearning on self-efficacy in higher education contexts (Lee et al., 2021; Liew et al., 2023; Romero-Rodríguez et al., 2023; Sözmen et al., 2023; Zarshenas et al., 2022). However, to our knowledge, self-efficacy has not yet been studied in the context of a large accumulation of microlearnings to form a macrolearning. The microlearning intervention in previous studies (Lee et al., 2021; Liew et al., 2023; Romero-Rodríguez et al., 2023; Sözmen et al., 2023; Zarshenas et al., 2022) was limited in terms of duration and number of lessons.

To address this knowledge gap, we propose the following research question: *How and why does macrolearning affect self-efficacy?* In response, this paper analyses the single case study of MLMaster (MLM), a successful EdTech startup with a portfolio of several macrolearnings in the business field. This article understands the concept of *macrolearning* as a concatenation of a significant number of microlearning units, in this case more than 150, forming a full curriculum with a flexible learning path designed to facilitate learning, satisfaction and engagement and to show participants' progress, and requiring the minimum investment in terms of time and money.

The main contribution of this article is to address a gap in the literature by exploring in depth how macrolearning affects self-efficacy. Results show that the majority of participants perceive a positive impact of the macrolearning programme on their self-efficacy, the main drivers of which are their affective states, or the positive feelings after taking part in the programme, and mastery experiences, or the application of learning at work. Vicarious learning, i.e., observing others, is also a strong driver of self-efficacy, while social persuasion has a lesser impact. These results are relevant for higher education institutions, given that most macrolearning participants are now choosing this option over the traditional master's degrees offered by universities and business schools.

The introduction is followed by a theoretical section that sets the frame for the research and identifies the gap. The methods section describes the case study chosen and the methodological process followed. The results section presents the empirical findings, evidenced by interviewees' direct quotations. The discussion considers the results in the light of the research questions and the theoretical background, limitations and future research proposals. Last, a concluding section provides an overall assessment of the paper with its highlighted contribution.

Theoretical Background

To answer the proposed research question, this section introduces the concept of self-efficacy in the context of higher education and then extends it to the particular context of microlearning.

Self-Efficacy in Higher Education

The construct of self-efficacy is defined as "beliefs in one's capabilities to organise and execute the courses of action required to produce given attainments" (Bandura, 1977, p.3), and "one's perceived judgement of their ability to perform a behaviour" (Puah et al., 2022, p372). Self-efficacy has been studied extensively in the context of higher education because it is considered "vital to academic performance" (Van Dinther et al., 2011, p.11) and a predictor of cognitive engagement (Aguilera-Hermida et al., 2021) given that it influences student motivation and learning. Self-efficacy can in turn be influenced by the higher education programme, such as when students are offered opportunities to apply knowledge and skills when performing authentic tasks (Van Dinther et al., 2011). This predicting and mediating role of self-efficacy in students' achievements, motivation and learning emphasises the importance given by higher education organisations to students' competency development by also focusing on students' self-efficacy development (Van Dinther et al., 2011) and implementing learning methodologies that engage and motivate students. As examples of these innovative methodologies, the use of a mobile chatbot (Chang et al., 2022) and augmented reality (Cai et al., 2021) in higher education have shown improvements in students' self-efficacy.

Individuals build self-efficacy beliefs by interpreting four sources of information (Bandura, 1997): (i) mastery experiences (authentic successes with specific situations and tasks); (ii) vicarious experiences (observing others / models, social comparison, knowledge sharing, peer feedback and support); (iii) verbal persuasion (persuasive communication and evaluative feedback from others); and (iv) physiological and affective states (impact of physical symptoms and

positive or negative feelings surrounding self-efficacy when the capability is used).

Macrolearning and Self-Efficacy in Higher Education

Self-efficacy has also been explored in the context of microlearning, which has been defined as "an instructional mode that targets a discrete, highly focused topic or skill, and provides small amounts of instruction that can be consumed in a short period of time and may be for immediate use" (Taylor & Hung, 2022, p.17). The essence of microlearning is to focus on one learning concept or learning objective at a time (Torgeson, 2021; Winger, 2018) through creating microlearning objects or units (Hug, 2021), which conceptually could be considered below the micro level of instructional design, i.e., the lesson (Kerres, 2007) or the "mini-lesson" (Taylor & Hung, 2022), as several units can represent a lesson. Microlearning is usually used as a supplement to face-to-face or online learning, but it can also be implemented successfully as a primary activity (Taylor & Hung, 2022). The number of peer-reviewed publications on microlearning have grown substantially in recent years, with research focusing on design, implementation, evaluation and mobile usage for microlearning (Sankaranarayanan et al., 2023). While microlearning effectiveness has been proven for skill-based training (Taylor & Hung, 2022; Zhang & West, 2020), the brevity of these units- usually 5 to 10 min (Taylor & Hung, 2022)- limits its capacity to small and discrete topics, such as informational or conceptual learning. The fragmentation of knowledge and the difficulty of integrating what students have learned through microlearning units, together with the inadequacy of this methodology to effectively display more integral or systemic topics (Taylor & Hung, 2022), are some of the deficiencies associated with this training modality.

An even smaller format than microlearning has more recently emerged, named nanolearning (Chamorro-Atalaya et al., 2024), where lessons are presented in very small and discrete units of just a few minutes duration (Radzitskaya & Islamov, 2024), and of even less than one minute in some extreme cases (Hamilton et al., 2021).

Most research finds a positive effect of microlearning on self-efficacy in higher education contexts (Lee et al., 2021; Liew et al., 2023; Romero-Rodríguez et al., 2023; Sözmen et al., 2023; Zarshenas et al., 2022). However, these studies have been based on learning with a very small number of microlearning units and for only a short period. For example, in Lee et al. (2021) the number of microlearning units that journalism students could access was limited to five lessons, each of no more than five minutes' duration. In Zarshenas et al. (2022), nursing students accesed five educational videos of short duration, averaging five minutes. In Liew et al. (2023), the microlearning intervention was limited to two weeks' duration, and consisted of nine videos and other short activities. In Sözmen et al. (2023), the microlearning materials were presented to medical students for a limited duration of 18 days. In Romero-Rodríguez et al. (2023), education and entrepreneurship students took part in a 3-week microlearning programme.

While short lessons are the main descriptor of microlearning (Taylor & Hung, 2022), this methodology offers the possibility of building a complete flow of instructional events organised around a key issue (Zhang & West, 2020), thereby creating a learning experience that may be equivalent to that of a full course when microlearning elements are curated and designed as intentional and connected concepts (Kohler et al., 2021). This opens the possibility of developing microlearning strategies at the meso level, referring to the course structure or module, and at the macro level, or a programme's overall curriculum (Kerres, 2007).

An accumulation of microlearning units can become a *macrolearning* programme that helps participants to learn via a learning pathway, with some authors arguing the importance of designing macrolearnings with a visual display of the student's progress (Baumgartner, 2013; Winger, 2018) to prevent them from becoming overwhelmed by the large number of bite-size lessons (Zhang & West, 2020). Although macrolearnings are growing in importance, their effectiveness remains understudied, and it is especially important to explore the capacity of macrolearning to develop less tangible knowledge, and to see if it can help develop complex competencies (Zhang & West, 2020). In spite of the existing gap, the effectiveness of macrolearning from a self-efficacy perspective has so far been overlooked (Kerres, 2007), especially in relation to a full curriculum (Liew et al., 2023). In prior studies (Lee et al., 2021; Liew et al., 2023; Romero-Rodríguez et al., 2023; Sözmen et al., 2023; Zarshenas et al., 2022), the microlearning interventions were limited in terms of duration and number of lessons, leaving a knowledge gap in terms of how and why a large concatenation of learning units can contribute to developing a student's complex competencies (Zhang & West, 2020).

Method

Research Context and Sample Design: MLMaster

To answer the research questions- how and why macrolearning affects self-efficacy- this paper is based on qualitative exploratory research, analysing a single case study. A qualitative approach is recommended when studying things and people in their natural settings and describing the meaning of the findings from the participants' perspective (Bloomberg & Volpe, 2016). The key point of qualitative research

is individuals' subjective experience (Cohen et al., 2007), thereby making it a suitable method to answer the research question of how and why macrolearning affects self-efficacy. Case studies provide rich data and facilitate the study of complex social phenomena (Yin, 2009). Given that the case study allows significant interaction with research participants (Bloomberg & Volpe, 2016), it is a useful research model to analyse and interpret the uniqueness of individuals and real situations through narratives, capturing the complexity of individuals' behaviour (Cohen et al., 2007). The aim of case studies is transferability, which is how the findings can be applied in similar contexts (Bloomberg & Volpe, 2016), contributing to developing theory to help researcher understanding of similar cases (Robson, 2002).

The selected case study was an EdTech startup headquartered in Spain, with a pioneering microlearning-based business model consisting of several business macrolearnings (e.g., MBA, Digital Marketing, etc.) made up of between 150 and almost 300 microlearning units (mainly videos but complemented with dynamic slides and other resources), each lasting between 5 and 10 min. The case, which we call MLMaster (MLM) to protect anonymity, has attracted over 100,000 alumni from more than 100 different countries since its launch seven years ago. The different programmes in the case study are offered on a paid basis, with prices ranging from 500 to 1,000 euros. Once enrolled, at their own pace participants follow a learning path that is pre-established by the platform, although in some programmes the student has the option of choosing between various modules. The content of the programme is sequenced, and a short test must be passed before being able to access the next module. Beyond these short tests, students do not have to do any additional teaching assignment, either individually or in groups. Students are not usually assigned a tutor, although the case study did provide this form of support in some of the first editions. Students have a maximum time to complete the programme, which is usually between 9 and 12 months. Once the programme is completed, the student receives the certification, and access to the platform is terminated. Students who are unable to complete the programme within the time limits are given the option of enrolling for an additional period.

The main strategy for participant selection was purposive sampling, or deliberately choosing the participants for the investigation based on researcher-defined criteria, thereby ensuring a satisfactory sample for the specific needs and purposes of the research (Cohen et al., 2007). The 12 student participants were contacted via LinkedIn, and the criteria was heterogeneity in several dimensions, including educational background, the MLM programme selected and the MLM programme status (completed, in progress, expired or unfinished). Nine participants were male and three were female.

Table 1 contains details of the participants interviewed, including gender, age bracket, educational background, the MLM programme studied and occupation. Secondary sources reviewed include information published on the company's website, microlearning videos offered as demos, press news, Google and social networks.

Data Sources

The empirical methodology combines primary and secondary sources of information. To increase trustworthiness, we pursued triangulation by using different sources and methods to corroborate the evidence obtained from the data (Bloomberg & Volpe, 2016). The main technique involved in this multi-method data collection method (Cohen et al., 2007) was the in-depth interview, complemented with a post-interview questionnaire administered to provide supportive evidence, although these answers were used only to rank and organise content. Documentation on the case study available on the company website, social networks and search engines was also reviewed.

Primary sources include in-depth individual interviews with 12 participants who enrolled in an MLM programme between 2018–2022, totalling 11 h and 13 min of interviews, with an average of 56 min per participant. Interviews were conducted via videoconference and audio recorded. All these data were transcribed verbatim by the research team, and then organised in tables differentiating research participants.

The field work for the interviews was carried out in September and October 2022. The in-depth interviews were complemented by a post-interview questionnaire to qualify results, including asking participants' about their perception of self-efficacy before and after completing the microlearning programme through eight statements adapted from a validated New General Self-Efficacy scale (Chen et al., 2001), where students provided their level of agreement with each statement on a 5-point Likert scale from strongly disagree to strongly agree. The data from the quantitative questionnaires were tabulated in spreadsheets to calculate total and average values. These data were complementary to the primary information provided by the interviews (Bloomberg & Volpe, 2016). Further, the data from the documentary review and/or observation were also used as a complementary source.

Data Analysis and Coding

Data analysis was based on the transcriptions of each participants' interview (intra-case analysis), followed by a cross-participant content analysis of the data to look for patterns and insights across individuals (inter-case analysis).

The information gathered was coded simultaneously but separately by two of the authors (Miles & Huberman,

Table 1 Interviewee profiles and the influence of MLM on their LinkedIn profile

Participant	Gender	Age bracket	MLM Programme	Educational background	Occupation
P1	M	41–45	MBA / Digital Marketing	Certificate in Marketing	Key accountant and sales and marketing expert
P2	M	41–45	MBA	Engineering / Master	Learning & development business partner
P3	F	41–45	Digital Marketing	Degree in business / Master Marketing	Master franchisee
P4	M	41–45	Digital Marketing	Degree in business / Master in new ventures	Business consultant and administrative manager
P5	M	31–35	MBA	Degree in business / Master in new ventures	Business Development
P6	M	51–55	MBA	Degree in fine arts / Master User Experience	Advisor and co-founder
P7	M	36–40	MBA	Public relations & Advertising degree / Master Digital Marketing	CEO and business developer
P8	M	36–40	Digital Marketing	Degree in business	Digital account manager
P9	F	41–45	MBA	Degree in business / Master in MK	Product manager
P10	M	46–50	Digital Marketing / Digital Transformation	Engineering / MBA	Director of digital transformation and innovation
P11	F	36–40	Digital Marketing + E-commerce (double)	Public relations & Advertising degree / Master Digital Marketing	Director of business development
P12	M	26–30	Digital Marketing	Degree in business	Sales Manager

F/M female/male. Abbreviations: MBA (Master of Business Administration)

1994; Strauss & Corbin, 1988), identifying primary codes for themes, secondary codes for sub-topics, and aggregate dimensions for themes derived from the data. Phrases or groups of phrases were coded using spreadsheets, and compared (interrater agreement: 0.75) and discussed until agreement was reached on coding and analysis. Table 2 shows the data structure, with the first-order concepts derived from participants' quotations, the second-order

Table 2 Data Structure and Codes

First-order concepts	Second-order themes	Aggregate dimensions
Feeling better prepared at work	**Affective states**	Personal enablers
High satisfaction with the level of detail of the lessons, or finding the programme better than expected or as expected	Feeling better prepared at work High satisfaction	
Gaining confidence	More confidence	
Motivation to go deeper into the topics or go at a faster pace	Go deeper / faster	
Reorder previous ideas and knowledge, global vision	Global vision / better understanding	
Attractiveness	**Attractiveness**	
	Highly attractive or attractive	
There were good speakers and good real cases in the videos	**Vicarious learning**	Social enablers
There were groups to resolve any problems, ask questions, interact and network	Good speakers / cases	
Having a mentor	Support and social networking	
Tests are simple, just for checking whether concepts were understood and to show progress	Have a mentor **Social persuasion**	
Good tests, clear, not easy, made you think, could fail, could repeat them, good automatic feedback	Tests simple and useful Repeat tests / automatic feedback	
Importance of a stronger brand or a better reputation for impact on the CV	Positive impact on the CV	
Increased 360-degree global vision and more strategic and open perspective of the company	**Social persuasion**	Contextual enablers
	Global, strategic vision	
Application of learnings at work	Apply knowledge at work	

themes from research-centric concepts, and the aggregate dimensions.

In a first phase, the first-order concepts were searched for using the different punctuation mechanisms available (e.g., word count). In a second phase, these first-order concepts were collapsed into second-order themes using a hybrid coding approach. We developed a hybrid coding or a hybrid approach to the thematic analysis (Swain, 2018). This approach is particularly useful when researchers want to ensure alignment with existing frameworks or theories while remaining open to new insights gained directly from the data. All first-order codes are the result of open coding, as are most of the second-order themes. Open codes or inductive coding were completely unconditioned, emerging from the data during analysis (Strauss & Corbin, 1988). We used predefined codes derived from the literature and free codes created during the analysis only for some second-order themes. More precisely, we used concepts of the self-efficacy theory, namely mastery experiences, vicarious experiences, verbal persuasion and physiological and affective states (Bandura, 1997).

Last, the aggregate dimensions came from open coding, derived from the data with the aim of identifying meanings in the transcribed interviews (Corbin & Strauss, 2015), and named personal enablers, contextual enablers and social enablers.

Results

In the following sub-sections, satisfaction with the programme is described and self-efficacy is presented and analysed.

Satisfaction

The programme carried out in MLMaster was valued as attractive by all the students, with four of them rating the programme as highly attractive, and the remaining eight as attractive. Reasons for this attractiveness were varied and include acquiring knowledge, the flexibility of the method, the entertainment it provided, the clarity of the explanations, the short format of the videos, and the practical cases, among others: "*The programme is attractive because of the flexibility, format and content of the videos*" (P6).

Results show that a macrolearning strategy such as the one developed by MLMaster is perceived as a real alternative to the traditional master's degrees offered by universities and business schools, as stated by one participant: "*I wanted to do an MBA for many years. MLMaster was an easy and relatively cheap way to try it. The risk was relatively small in terms of the time commitment and the financial cost involved*" (P9).

Self-Efficacy

Participants were asked to answer a specific question designed to assess whether the MLMaster programme had affected their self-efficacy: *Has the MLMaster helped you to improve your competence to achieve performance in a wide variety of professional situations*?

The results show that eight of the 12 participants saw a positive impact of the MLMaster programme in terms of self-efficacy improvement, stating reasons such as greater confidence to carry out actions and/or take part better in conversations in the professional environment (P1, P4, P10); having a more global and strategic vision (P7, P9); new knowledge or reinforcement of previous knowledge (P2, P4, P6, P9, P10), and better structuring and organisation of ideas (P6, P10, P11).

Among the four members whose self-efficacy did not improve on completing the programme, the main reasons were that the knowledge did not help with the challenges of their job (P12); that they had enough previous knowledge or experience (P3, P8), and they did not finish the programme (P5).

Among the group of students whose self-efficacy increased on completing the macrolearning programme, all the eight members were able to apply the new knowledge in the work environment, some of them at a low level (P1, P2, P9, P11), two of them moderately (P4, P7), and two at a high level (P6, P10). Three-quarters of the group, or six out of the eight participants, chose a programme related to previous studies but with different levels of similarity, either related with similar topics of study (P2, P11), or related but overlapping only slightly (P4, P7, P9, P10). The other two participants had previously studied unrelated topics (P1, P6). The main motivation for enrolling was to learn (six out of eight participants), and of the six, five achieved effective learning (P1, P4, P6, P7, P10) and one refreshed knowledge (P11). The other two students enrolled out of curiosity, one of them achieving unexpected learning (P9) and the other entertainment (P2).

The main motivation to enrol in the programme seems to have no effect on the subsequent improvement in self-efficacy, since of the eight participants who enrolled with the motivation to learn, six managed to increase self-efficacy (P1, P4, P6, P7, P10, P11) and two did not (P3, P8), while of the four who enrolled out of curiosity, half increased self-efficacy (P2, P9) and half did not (P5, P12).

Four Sources to Build Self-Efficacy

This section presents the findings regarding the effect of the four sources of self-efficacy (Bandura, 1997) in order of importance (see Table 3 for more details), starting with the group of students who increased their self-efficacy.

Table 3 Four sources to build Self-efficacy

Changes in Self-efficacy	Sources of Self-efficacy	Highlights of quotations	Participants											
			P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12
Improvement in Self-Efficacy	Mastery experiences	Increased 360-degree global vision and more strategic and open perspective of the company	•					•	•					
		Application of learnings at work	•	•		•		•	•		•	•	•	
	Vicarious learning	Good speakers and good real cases in the videos	•			•		•	•		•		•	
		Groups (WhatsApp, Facebook, LinkedIn, Telegram) to resolve any problems, ask questions, interact and network	•	•										
		Having a mentor	•											
	Social persuasion	Perceived as positive that tests are simple, just for checking whether concepts were understood and to show progress				•			•				•	
		Good tests, clear, not easy, made you think, could fail, could repeat them, good automatic feedback												
		Importance of a stronger brand for MLMaster or a better reputation for impact on the CV						•				•		
	Affective states	Feeling better prepared at work	•					•						
		High satisfaction with the level of detail of the lessons, or finding the programme better than expected or as expected				•			•				•	
		Gaining confidence				•						•		
		Motivation to go deeper into the topics or go at a faster pace				•			•		•	•		
		Helpful to reorder previous ideas and knowledge, global vision						•	•		•			
No improvement in Self-Efficacy	Mastery experiences	Lack of enough detail to apply learnings at work, or inability to apply what was learned on the job			•									•
		Missing practical activities in the programme			•					•				
		Missing tutoring / personal feedback								•				
		No real learning					•							
	Vicarious learning	Bad speakers in the videos, too ego-centric or arrogant			•		•							
		Lacking an online group for interacting and resolving problems			•									
		Deciding not to participate in debates, chats and forums, or not finding value in the tools for interactivity			•		•			•				•
		No interactivity with the teachers			•									
	Social persuasion	Perceived as positive that tests are easy but with no practical exercises included in the assessment			•					•				
		Perceived as negative to be able re-do the tests when failed												•
		Social pressure to enrol due to an abundance of ads on social networks, many positive testimonials, very positive and powerful brand image, very easy publication of the certificate on LinkedIn, and a sense that they are democratising the world of master's degrees			•		•			•				

Table 3 (continued)

Changes in Self-efficacy	Sources of Self-efficacy	Highlights of quotations	Participants											
			P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12
		Communication message that is too playful and not focused on learning			•									
	Affective states	The course expires and access to content is lost			•					•				
		Lack of personal contact, feeling of just being a number			•									
		Lacking sufficient motivation to continue					•							
		Some content below expectations												•

First, "*affective states*" were mentioned 14 times, the most positive feelings associated with feeling better prepared at work (P1, P6): "*I have a different vision when I visit clients, and I know things I did not know before about a company, more at a global level"* (P1); high satisfaction with the programme (P4, P7, P11): "*Learning objectives 100% achieved. What you really learn is to have a 360 view of a company, and that is very interesting*" (P7); gained confidence (P4, P10), motivation to delve deeper into the topics or go at a faster pace (P4, P7, P9, P10), and ability to reorder previous ideas and knowledge, and a global vision (P6, P7, P9).

Second, "*mastery experiences*" was mentioned 11 times, associated with an increased 360-degree global vision and a more strategic and open perspective of the company (P1, P6, P7), and application of learnings at work (P1, P2, P4, P6, P7, P9, P10, P11): "*I have applied the knowledge at work because it has given me an insight into things and more control, and there are fewer surprises, and I can take greater advantage of opportunities. It has widened my perspective on things*" (P6).

Third, "*vicarious learning*", with nine mentions, mainly concerned satisfaction with the speakers/real cases (P1, P4, P6, P7, P9, P11): "*In the videos, there were powerful people […], high profile speakers from good companies*" (P1); the support and networking groups on social networks (P1, P2): "*The most positive thing was a lot of cooperation between students, a lot of networking*" (P2), and the chance to have a mentor (P1).

Fourth, "*social persuasion*", with eight mentions, was related to a positive perception of the tests, described as simple and useful for checking if concepts had been understood and to show progress (P4, P7, P11): "*There are no exams, there is a test at the end of each module, which is very easy. I think this is very good*" (P11); and as clear and not easy since they make the student think, with the fact that they could be repeated with automatic feedback seen as positive (P6, P9, P10). The role of the "MLMaster" brand and its impact on the CV is also perceived as positive: "*It allows you to do an increasingly recognised and well-known course at a super reasonable price; it is very economical*" (P10), although there was a desire for increased brand strength and reputation: "*What I would like is for MLMaster to make its brand stronger. I would like it if the MLMaster brand shined a little more on my CV*" (P6).

Regarding the second group of students, who did not increase self-efficacy, a very different ranking of the sources of self-efficacy were found. First, the most mentioned at eight times was "*vicarious learning*", with several participants perceiving no value in interactions that could reinforce learning (e.g., knowledge sharing in debates, peer feedback in forums, and support between students in chats) (P3, P5, P12, P8); perceiving the models used as speakers in the videos as not suitable (e.g., too ego-centric or arrogant) (P3,

P5); missing having an online group for interacting and resolving problems (P3), and finding interaction (e.g., with other students and professors) to be missing (P3). Second, "*social persuasion*" was mentioned seven times, related to easy tests (P3), tests that can be redone (P12), no practical activities (P8), not serious learning (P3), and social pressure to enrol (P3, P5, P8). Third, "*mastery experiences*", with five mentions, was associated with a lack of detail to be able to apply learnings at work (P3, P12); lacking in practical activities that could act as a driver of capability to perform subsequent tasks (P8, P3); lacking in tutoring / personal feedback (P8), and no real learning (P5). Fourth, "*affective states*" were mentioned five times, including not having access to content after the programme has expired (P8, P3); feeling as if they were just a number (P3); feeling insufficiently motivated to finish the programme (P5), and finding some content below expectations (P12).

Discussion

Contribution to Research

This research makes several contributions. First, we contribute by adding empirical research on how self-efficacy is enhanced in the context of a large accumulation of microlearnings to form a macrolearning, since in previous studies the intervention groups were provided with a very small number of microlearning units, for example only five (Lee et al., 2021; Zarshenas et al., 2022), or the programme was of short duration (e.g., three weeks) (Romero-Rodríguez et al., 2023). Results show how a sizable quantity of short videos and microlearning objects, structured in a well-thought-out programme of average difficulty with a total duration of between nine and 12 months can improve the self-efficacy of most participants. Main reasons for this self-efficacy improvement are greater confidence to carry out actions and/or be involved in conversations in the professional environment, having a more global and strategic vision, new knowledge or reinforcement of previous knowledge, and better structuring and organisation of ideas. Although some of the students did not improve their self-efficacy, all of them found the programme attractive or very attractive. These results contribute to the unexplored issue of self-efficacy in macrolearning, and is aligned with existing findings that have showed the capacity of microlearning to improve self-efficacy (Lee et al., 2021; Romero-Rodríguez et al., 2023; Sözmen et al., 2023; Zarshenas et al., 2022). The importance of this research is that it supports the idea that macrolearning seems to be capable of preserving the proven effectiveness of microlearning.

Second, the results also contribute to exploring whether grouping microlearning lessons affects the perception and ability of learners to form complex competencies (Zhang & West, 2020), and if microlearning can be effective in responding to complex questions where the answers are unknown (Lee et al., 2021), as is the case in the context of business management (e.g., *How should I manage my company?*). The learners that improved their self-efficacy have the common characteristic that they all applied the knowledge in their current work, although at different levels, contributing to the unexplored field of macrolearning effectiveness, and specifically to measures of self-efficacy. These results also show that a macrolearning programme such as the one offered by MLMaster could be perceived as a real alternative to the traditional master's degrees offered by universities and business schools. These results contribute by showing that a macrolearning can be implemented successfully as a primary activity and not only as a complement to traditional programmes, confirming prior research in the context of microlearning (Taylor & Hung, 2022). These results achieved in the context of a macrolearning programme contribute to confirming previous research done at the microlearning level that has found that using microlearning can increase students' motivation and self-confidence, help them to achieve complex learning goals (Sözmen et al., 2023), and raise self-efficacy (Romero-Rodríguez et al., 2023).

Third, the results revealed differences in mentions of the impact of the four sources of self-efficacy building among participants who improved their self-efficacy and those who did not. In order of importance, students who improved their self-efficacy stated: i) "*affective states*", ii) "*mastery experiences*", iii) "*vicarious learning*" and iv) "*social persuasion*", thereby contributing to prior research findings in the context of a macrolearning programmes in the higher education context on how students can develop self-efficacy (Van Dinther et al., 2011), and answering calls for further research in different academic settings (Anders, 2018). Students who did not improve their self-efficacy reported, in order of importance: i) "*vicarious learning*", ii) "*social persuasion*", iii) "*mastery experiences*" and iv) "*affective states*".

The most relevant difference between the two groups was in the "affective states" dimension, most mentions of which were by the group that increased self-efficacy. The drivers of these *positive feelings* were mainly i) feeling better prepared at work, ii) high satisfaction with the programme and iii) gained confidence. Mastery experiences such as successes in specific situations and tasks occurred more frequently in the group that improved self-efficacy, especially as the programme was perceived to increase 360-degree global vision and a more strategic and open perspective of the company, and because learnings can be applied. Vicarious learning is a strong self-efficacy driver, receiving positive comments relating to good speakers and real cases from most of the participants who increased self-efficacy. The role of peer

interactions, collaborative learning and support between students is also a clear source of self-efficacy building, as is social persuasion, particularly regarding the evaluative dimension and feedback mechanisms, where the fact that that tests were simple and useful to check if concepts had been understood and to show progress was seen as positive. Persuasive communication has a limited effect in terms of convincing the individual of their capabilities, and in many cases communication that is considered too aggressive or marketing-oriented is considered negative because MLM is a learning programme. Figure 1 summarises the process of enhancing self-efficacy after taking part in a macrolearning programme.

Managerial Implications for Higher Education

This empirical research has several practical implications. The findings presented provide insights that encourage reflection on the future of higher education since microlearning is perceived as an attractive learning methodology by students, and results show that it can improve self-efficacy. The analysis of an EdTech in business education is of great value for the higher education and business schools sector, since the company has successfully amalgamated several hundred microlearning units into a ***macrolearning***, with several of its students enrolling in the programme as a substitute for a traditional masters.

The first implication is that designers of macrolearning programmes, as higher education academic experts, EdTech entrepreneurs and corporate training specialists, can leverage insights derived from the positive and negative mentions of the impact of the four sources of participants' self-efficacy building in the MLMaster programme, namely "*affective states*", "*mastery experiences*", "*vicarious learning*" and "*social persuasion*". These findings are especially relevant for programme designers who want to build a full curriculum.

Second, directors of higher education institutions and business schools can join this macrolearning trend by offering macrolearning curricula, which function as completely stand-alone programmes. This option would allow universities to offer programmes that are highly up-to-date in terms of content and that cover the need that students have for lifelong learning, expanding its business model in the process as the new offering could target both alumni and new students. As a less ambitious but equally interesting alternative, macrolearnings could be integrated into other programmes, experimenting with hybrid models. The result would reduce or eliminate some of the drawbacks of MLMaster programmes associated with lack of participation, loose assessment and lack of interactivity with other students, professors and tutors, leveraging the flexibility, agency and format that microlearning delivers. If higher education institutions cooperate and join forces (e.g., by embracing open education resources), a winning macrolearning strategy could flourish, contributing to making a globalised education possible if full online macrolearning programmes are expanded, making progress towards achieving SDG target 4 (United Nations, 2024), which pursues a more inclusive and equitable quality education and lifelong learning.

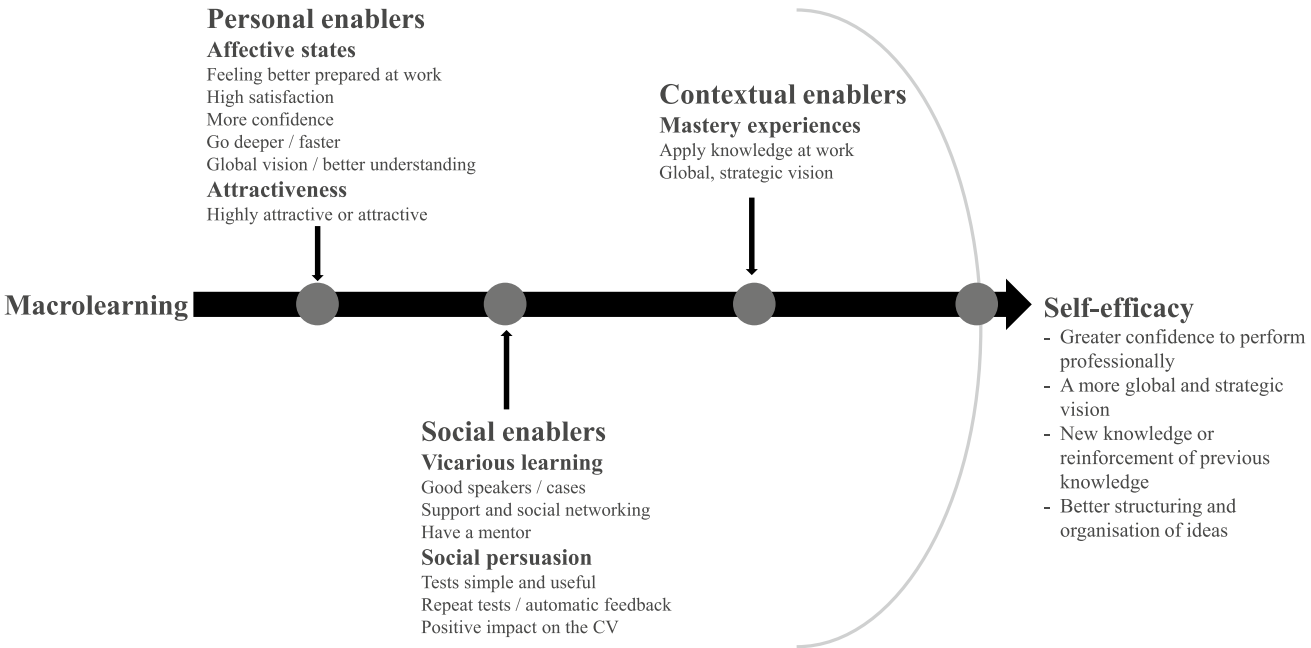

Fig. 1 The process of enhancing self-efficacy after taking part in a macrolearning programme

Limitations

This paper is subject to some limitations regarding its methodology and findings. The contribution is limited due to the use of a single case study from the specific EdTech sector. A caveat of case studies is that the goal is transferability and not generalisation (Bloomberg & Volpe, 2016). This means that this research should be considered exploratory and theory-grounding, which is appropriate when little is known about a phenomenon (Bloomberg & Volpe, 2016), contributing to developing theory to help researcher understanding of other similar cases (Robson, 2002) where the results could be applied (Bloomberg & Volpe, 2016). To this effect, the results may not be generalisable apart from in contexts or cases where other researchers see their application (Cohen et al., 2007). Another limitation is that the results are not easily open to cross-checking and can be exposed to problems of observer vias (Cohen et al., 2007). A further point to bear in mind is that the study of the impact of macrolearning on self-efficacy was conducted only on the basis of students' perceptions. Other perspectives, such as that of the employer, could provide different visions of this impact. Last, in this research we consider self-efficacy as a unidimensional concept, while it is likely to be a multidimensional and gradual concept.

Future Research

Future research should validate our findings and answer some unanswered questions, such as whether the initial perception of self-efficacy gained from the learning achieved can later translate into better job performance or better job opportunities. Further research is needed to compare a microlearning programme and a traditional programme in its different versions- face-to-face, online and hybrid- in a similar context. Another area of future exploration is the challenge of managing student participation and interaction. This is an area where technology should support at its best, as providing the individualised feedback expected by the student in a low-cost macrolearning environment such as MLMaster is only feasible with the use of new technologies. The macrolearning user will engage and interact when it is fast and easy, and they are getting great value for their time. Although the debate on social learning and student internal agency (Bandura, 2001) began more than two decades ago, new technologies make the issues involved ever present.

Conclusions

Our study responds to the various calls for more research to better understand macrolearning efficacy and its capacity to develop complex competencies (Zhang & West, 2020). As a concatenation of microlearning, macrolearning shares some of the findings of previous research on microlearning, also showing from the self-efficacy perspective that it can be perceived as a real substitute for a traditional masters. This paper contributes to the limited peer reviewed literature on macrolearning.

First, the paper explores *macrolearning*, showing that if the sequence is adequate and there is a sizable quantity of short videos and microlearning objects structured in a well-thought-out programme of average difficulty, the self-efficacy of most participants can be improved, with all of them finding the programme attractive or highly attractive. Second, a macrolearning can be effective for learning complex disciplines, as this research is set in the context of business management (e.g., *How should I manage my company?*), with the application of knowledge in their current job being a common characteristic among all the learners with self-efficacy improvement. Third, "*affective states*" (e.g., feeling better prepared at work and high satisfaction with the programme) are the most important drivers to build self-efficacy, followed by "*mastery experiences*" (e.g., improved performance at work). The other sources of self-efficacy building have a lower influence, with "*vicarious learning*" showing polarising effects due to different preferences of the participants regarding speakers, professors and levels of interaction, among others; and "*social persuasion*", showing a limited/non-existent effect of persuasive communication and evaluative feedback from others in convincing the individual about their capabilities.

Higher education institutions should be considering whether microlearning is a threat or an opportunity. Macrolearning, as a highly scalable educational strategy, breaks the time, cost and quality restrictions that have historically constrained higher education institutions. This paper argues that higher education institutions, which are immersed in a digital transformation process (Rahmadi, 2024; Rof et al., 2020), should embrace macrolearning as an opportunity, leveraging its unique strengths to develop a better learning value proposition for students and a better business model (Rof et al., 2022) to complement its primary mission of teaching and research with a third mission, contribution to society (Compagnucci & Spigarelli, 2020).

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Data Availability The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

Declarations

Ethics Statement Informed consent was obtained from all the individual participants included in the study.

Research Involving Human Participants and/or Animals This study, which involved human participants, was in accordance with the ethical standards of the institutional research committee.

Financial Interests The authors declare they have no financial interests.

Conflict of Interest There were no conflicts of interest in this research.

References

Aguilera-Hermida, A. P., Quiroga-Garza, A., Gómez-Mendoza, S., Del Río Villanueva, C. A., Avolio Alecchi, B., & Avci, D. (2021). Comparison of students' use and acceptance of emergency online learning due to COVID-19 in the USA, Mexico, Peru, and Turkey. *Education and Information Technologies, 26*(6), 6823–6845. https://doi.org/10.1007/S10639-021-10473-8

Anders, A. D. (2018). Networked learning with professionals boosts students' self-efficacy for social networking and professional development. *Computers & Education, 127*, 13–29. https://doi.org/10.1016/J.COMPEDU.2018.08.009

Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review, 84*(2), 191–215. https://doi.org/10.1037/0033-295X.84.2.191

Bandura, A. (1997). *Self-efficacy: The exercise of control*. W.H. Freeman and Company.

Bandura, A. (2001). Social Cognitive Theory: An Agentic Perspective. *Annual Review Of Psychology, 52*, 1–26. https://doi.org/10.1146/Annurev.Psych.52.1.1

Baumgartner, P. (2013). *Educational dimensions of microlearning – towards a taxonomy for microlearning*. Retrieved from https://api.semanticscholar.org/CorpusID:14129479

Bloomberg, L. D., & Volpe, M. (2016). *Completing your qualitative dissertation: A road map from beginning to end* (3rd ed.). Sage.

Cai, S., Liu, C., Wang, T., Liu, E., & Liang, J. C. (2021). Effects of learning physics using augmented reality on students' self-efficacy and conceptions of learning. *British Journal of Educational Technology, 52*(1), 235–251. https://doi.org/10.1111/bjet.13020

Chamorro-Atalaya, O., Flores-Velásquez, C. H., Olivares-Zegarra, S., Dávila-Ignacio, C., Flores-Cáceres, R., Arévalo-Tuesta, J. A., …,& Suarez-Bazalar, R. (2024). Microlearning and Nanolearning in Higher Education: A Bibliometric Review to Identify Thematic Prevalence in the COVID-19 Pandemic and Post-Pandemic Context. *International Journal of Learning, Teaching and Educational Research*, *23*(4), 279–297. https://doi.org/10.26803/ijlter.23.4.15

Chang, C. Y., Hwang, G. J., & Gau, M. L. (2022). Promoting students' learning achievement and self-efficacy: A mobile chatbot approach for nursing training. *British Journal of Educational Technology, 53*(1), 171–188. https://doi.org/10.1111/bjet.13158

Chen, G., Gully, S. M., & Eden, D. (2001). Validation of a new general self-efficacy scale. *Organizational Research Methods, 4*(1), 62–83. https://doi.org/10.1177/109442810141004

Cohen, L., Manion, L., & Morrison, K. (2007). *Research methods in education*. Routledge.

Compagnucci, L., & Spigarelli, F. (2020). The Third Mission of the university: A systematic literature review on potentials and constraints. *Technological Forecasting and Social Change, 161*, 120284. https://doi.org/10.1016/j.techfore.2020.120284

Corbin, J., & Strauss, A. (2015). *Basics of qualitative research* (4th ed.). SAGE Publications Inc. Retrieved January 22, 2021 from: https://us.sagepub.com/en-us/nam/basics-of-qualitative-research/book235578

Dolasinski, M. J., & Reynolds, J. (2023). Microlearning in the higher education hospitality classroom. *Journal of Hospitality and Tourism Education, 35*(2), 133–142. https://doi.org/10.1080/10963758.2021.1963748

Hamilton, J., Hall, D., & Hamilton, T. (2021). Microlearning in the workplace of the future. In M. E. Corbeil, J. R. Corbeil, & B. H. Khan (Eds.), *Microlearning in the digital age* (pp. 240–263). Routledge.

Hug, T. (2021). Sound pedagogy practices for designing and implementing microlearning objects. In M. E. Corbeil, J. R. Corbeil, & B. H. Khan (Eds.), *Microlearning in the digital age*. Routledge.

Kerres, M. (2007). Microlearning as a challenge for instructional design. In T. Hug (Ed.), *Didactics of microlearning* (pp. 98–109). Waxmann.

Kohler, M., Gamrat, C., Raish, V., & Gross, E. (2021). Microlearning and micro-credentials in higher education. In M. E. Corbeil, J. R. Corbeil, & B. H. Khan (Eds.), *Microlearning in the Digital Age* (pp. 111–128). Routledge.

Lee, Y. M., Jahnke, I., & Austin, L. (2021). Mobile microlearning design and effects on learning efficacy and learner experience. *Educational Technology Research and Development, 69*(2), 885–915. https://doi.org/10.1007/s11423-020-09931-w

Liew, S. C., Tan, M. P., Breen, E., Krishnan, K., Sivarajah, I., Raviendran, N., … Pallath, V. (2023). Microlearning and online simulation-based virtual consultation training module for the undergraduate medical curriculum – a preliminary evaluation. *BMC Medical Education*, *23*(1), 796. https://doi.org/10.1186/s12909-023-04777-1

Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis: An expanded sourcebook*. Thousand Oaks.

Paul, A. M. (2016). Microlearning 101. *HR Magazine, 61*(4), 36–42.

Puah, S., Bin Mohmad Khalid, M. I. S., Looi, C. K., & Khor, E. T. (2022). Investigating working adults' intentions to participate in microlearning using the decomposed theory of planned behaviour. *British Journal of Educational Technology, 53*(2), 367–390. https://doi.org/10.1111/BJET.13170

Radzitskaya, Y., & Islamov, A. (2024). Nanolearning approach in developing professional competencies of modern students: Impact on self-regulation development. *Journal of Computer Assisted Learning, 40*(3), 1154–1165. https://doi.org/10.1111/jcal.12943

Rahmadi, I. F. (2024). Research on digital transformation in higher education: Present Concerns and future endeavours. *TechTrends, 2024*, 1–14. https://doi.org/10.1007/S11528-024-00971-0

Robson, C. (2002). *Real world research: A resource for social scientists and practitioner-researchers*. Wiley-Blackwell.

Rof, A., Bikfalvi, A., & Marques, P. (2020). Digital transformation for business model innovation in higher education: Overcoming the tensions. *Sustainability, 12*(12), 4980.

Rof, A., Bikfalvi, A., & Marques, P. (2022). Pandemic-accelerated digital transformation of a born digital higher education institution:

Towards a customized multimode learning strategy. *Educational Technology and Society, 25*(1), 124–141.

Romanenko, Y. N., Solodovnikova, E., & Maksimenko, N. (2023). Microlearning as a new method of teaching soft skills to university students. *Frontiers in Education*, *8*. https://doi.org/10.3389/FEDUC.2023.1177516

Romero-Rodríguez, J. M., Ramirez-Montoya, M. S., Glasserman-Morales, L. D., & Ramos Navas-Parejo, M. (2023). Collaborative online international learning between Spain and Mexico: A microlearning experience to enhance creativity in complexity. *Education and Training, 65*(2), 340–354. https://doi.org/10.1108/ET-07-2022-0259

Sankaranarayanan, R., Leung, J., Abramenka-Lachheb, V., Seo, G., & Lachheb, A. (2023). Microlearning in diverse contexts: A bibliometric analysis. *TechTrends, 67*(2), 260–276. https://doi.org/10.1007/S11528-022-00794-X

Sözmen, E. Y., Karaca, O., & Batı, A. H. (2023). The effectiveness of interactive training and microlearning approaches on motivation and independent learning of medical students during the COVID-19 pandemic. *Innovations in Education and Teaching International, 60*(1), 70–79. https://doi.org/10.1080/14703297.2021.1966488

Strauss, A., & Corbin, J. (1988). *Basics of qualitative research: Techniques and procedures for developing grounded theory*. SAGE.

Sun, G., Cui, T., Yong, J., Shen, J., & Chen, S. (2018). MLaaS: A cloud-based system for delivering adaptive micro learning in mobile MOOC learning. *IEEE Transactions on Services Computing, 11*(2), 292–305. https://doi.org/10.1109/TSC.2015.2473854

Swain, J. (2018). A hybrid approach to thematic analysis in qualitative research: Using a practical example. *Sage Research Methods*. https://doi.org/10.4135/9781526435477

Taylor, A., & Hung, W. (2022). The effects of microlearning: A scoping review. *Educational Technology Research and Development*. https://doi.org/10.1007/S11423-022-10084-1

Torgeson, C. (2021). What is microleaning? Origin, definitions, and apllications. In M. E. Corbeil, J. R. Corbeil, & B. H. Khan (Eds.), *Microlearning in the Digital Age* (pp. 14–31). Routledge.

United Nations. (2024). Goal 4 (sustainable development goals), Department of Economic and Social Affairs. Retrieved February 14, 2022, from Sustainable Development website: https://sdgs.un.org/goals/goal4

Van Dinther, M., Dochy, F., & Segers, M. (2011). Factors affecting students' self-efficacy in higher education. *Educational Research Review, 6*(2), 95–108. https://doi.org/10.1016/J.EDUREV.2010.10.003

Winger, A. (2018). Supersized tips for implementing microlearning in macro ways [Article]. *Distance Learning, 15*(4), 51–55.

Yin, R. K. (2009). *Case study research: Design and methods* (4th ed.). Sage Publications.

Zarshenas, L., Mehrabi, M., Karamdar, L., Keshavarzi, M. H., & Keshtkaran, Z. (2022). The effect of micro-learning on learning and self-efficacy of nursing students: an interventional study. *BMC Medical Education*, *22*(1). https://doi.org/10.1186/S12909-022-03726-8

Zhang, J., & West, R. E. (2020). Designing microlearning instruction for professional development through a competency based approach. *TechTrends, 64*(2), 310–318. https://doi.org/10.1007/s11528-019-00449-4