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<https://doi.org/10.1057/s41599-024-03719-6>

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Does participating in online communities enhance the effectiveness and experience of micro-learning? Evidence from a randomized control trial

Jiawen Zhu ^{1✉}, Hao He², Yiran Zhao ³ & Miaoting Cheng⁴

In the age of information explosion, people are increasingly accustomed to acquiring knowledge during fragmented periods of time, which has contributed to the growing popularity of micro-learning. However, when micro-learning takes place in non-formal or informal settings, it can be easily disrupted and may lack interaction, negatively impacting the learning experience and knowledge acquisition. This study examined the effect of learning communities on knowledge acquisition and learning experience in non-formal micro-learning settings. An 8-module micro-learning course was designed, and 80 participants were divided into an experimental group with a learning community and a control group without one. All participants completed a pre-test and post-test. The results showed significant improvements in post-test scores for both groups, with no notable difference in knowledge acquisition between them. Learners who took notes and repeatedly reviewed the learning content tended to have higher post-test scores. In addition, differences between the groups in terms of mental effort and satisfaction were insignificant. By the end of the course, the control group expressed a stronger desire to join a learning community. Community learners who made significant progress reported enjoying learning within the community, while those who did not regularly check community messages and experienced a decrease in test scores reported that excessive messaging caused distress. These findings have implications for course designers and researchers aiming to enhance micro-learning through online learning communities.

¹ Faculty of Education, East China Normal University, Shanghai, China. ² School of Library and Information Management, Emporia State University, Emporia, KS, USA. ³ Department of Educational Studies, Academy of Future Education, Xi'an Jiaotong-Liverpool University, Suzhou, China. ⁴ Department of Educational Technology, Faculty of Education, Shenzhen University, Shenzhen, China. ✉email: zhujiawen@ed.ecnu.edu.cn

Introduction

In the age of information explosion, people are increasingly getting used to searching for information and acquiring knowledge in their spare and fragmented time. Individuals are now more inclined to engage with concise, bite-sized content (Emerson and Berge, 2018; Sankaranarayanan et al., 2023). Microlearning has emerged as a pivotal instructional strategy to address this shift and reduce the cognitive load, offering access to relatively small learning units. Microlearning is an instructional unit that enables a short engagement in an activity intentionally designed to elicit a specific outcome from the participant (Kapp and Defelice, 2019, p. 21).

Microlearning's application spans formal, non-formal, and informal learning settings, where its design plays a crucial role (Jahnke et al., 2020). Beyond content creation, establishing an effective learning mechanism is essential (Buchem and Hamelmann, 2010). Zhang and West (2020) emphasized the importance of integrating microlearning with learner interactions, including peer-to-peer, learner-to-expert, and learner-to-content engagements.

Despite recognizing interactions in learning communities as beneficial to microlearning, which is aligned with the Community of Practice theory (Wenger et al., 2002), integrating these learning communities with microlearning strategies remains insufficiently explored. Although Emerson and Berge (2018) advocated for leveraging online communities to enhance informal learning through microlearning modules, and Göschlberger (2017) identified social media as a potent tool for fostering learner communication, comprehensive strategies for their effective integration are scarce.

This gap is particularly pronounced in settings where microlearning occurs in informal or non-formal contexts, often characterized by learners engaging in self-directed learning in their own time, occasionally isolated from peer support. Challenges such as information overload and difficulties discerning online content further intensify the need for structured guidance (Lu et al., 2019). Additionally, there is a noted scarcity of research evaluating the effectiveness of microlearning within learning communities and perceptions by learners (Lee et al., 2021; McNeill and Fitch, 2023; Taylor and Hung, 2022), leaving unanswered questions about the role of online communities in facilitating microlearning and enhancing the learning experience. Specifically, how does using online learning communities in microlearning affect learners' knowledge acquisition and learning experience?

In order to address these gaps, this study examines the impact of online learning communities on microlearning within a social media-based, non-formal learning context. It aims to elucidate how these communities can be integrated with microlearning strategies and to develop improved materials and activities for community-based microlearning. Through this exploration, the study contributes novel insights into the design and implementation of microlearning environments, establishing a foundation for future academic research and practical applications in digital learning spaces.

Related work

Many individuals feel pressed for time to learn in the fast-paced modern world. At the same time, there is a growing emphasis on professional development and lifelong learning. Against this backdrop, microlearning has emerged as a growing trend in lifelong learning (Giurgiu, 2017). Interest in microlearning has surged recently, evidenced by the substantial increase in publications on this topic, as it has garnered significant attention from scholars in the instructional design and technology

disciplines (Kohnke et al., 2024; Sankaranarayanan et al., 2023). Concise learning content enables individuals to efficiently use their limited and fragmented time to access needed information.

Microlearning can be implemented in formal, informal, and non-formal settings. Most research on microlearning focuses on K-12, higher education, or corporate training contexts (Sankaranarayanan et al., 2023). Microlearning often serves as supplementary material to traditional classroom content. Teachers often chunk learning materials for students through infographics (Ozdamli et al., 2016) or flashcards (Edge et al., 2012) and provide timely feedback. Students who adapt to the microlearning approach often find it a better learning experience than traditional face-to-face learning (Mohammed et al., 2018).

Reflecting its versatile nature, microlearning extends beyond traditional school settings. Corporations can make training content accessible to their employees through microlearning lessons. This form of work-based short-term training is known as microtraining (Buchem and Hamelmann, 2010). Such microlearning reduces training pressure and increases companies' competitive advantage (Dolasinski and Reynolds, 2020). In addition, this learning approach does not require employees to be in a specific location or at a specific time during training, eliminating the time and physical space constraints for employees and reducing training costs.

Microlearning is often used in non-formal and informal forms, implying that learners are in a more spontaneous state to acquire knowledge. They may complete microlearning online by independently searching for information or taking some online microlearning courses. Scholars generally agree that microlearning can help learners acquire information, reduce cognitive load, achieve high satisfaction, and have a good learning experience (Buchem and Hamelmann, 2010; Giurgiu, 2017). However, studies have yet to explore the impact of peer interaction in a community on microlearning.

Unlike microlearning, which occurs in formal and corporate training settings, microlearning in non-formal and informal settings expects learners to learn spontaneously. However, research indicates that effective learning involves consuming content to replicate expert knowledge and creating content through social interaction and exploration (Buchem and Hamelmann, 2010). By transforming their role from consumer to producer, learners are more motivated and take greater responsibility for achieving their learning goals. This role transformation, in turn, requires learners to be more proactive in interacting with others and applying the information they learn, thus making it easier to acquire knowledge. Abed et al. (2024) and Wang et al. (2017) support that there were significant differences in scores between learners who actively interacted with the instructor and those who did not respond to instructor messages.

Online learning communities provide an environment for learners to communicate with others. They are commonly used in formal learning settings, with positive outcomes (Wu et al., 2017). Online learning communities promote collaboration among learners and enhance their competencies in a particular area. Based on the Community of Practice theory (Wenger et al., 2002), our study explored the impact of microlearning in a community on learners' knowledge acquisition and learning experience. Researchers have found that learners who learn in communities have improved learning performance and achieve higher satisfaction (Jiménez-Zarco et al., 2015). Additionally, these communities facilitate microlearning beyond the classroom setting. Such learning communities are often linked to professional development (Chen et al., 2014). Learners are self-driven to communicate and share in learning communities.

However, the impact of joining learning communities on learners' knowledge acquisition and learning experience in microlearning has yet to be conclusively determined. A case study showed that most learners preferred to learn independently rather than in a group, and many felt that they enjoyed receiving information more than producing it (Buchem and Hamelmann, 2010). Speily and Kardan (2018) also pointed out that most learners in online learning communities remained latent, and learners from different backgrounds caused a decrease in communication and information sharing. Lu et al. (2019) and Kumar et al. (2023) also noted that too much online information might affect learners' information recognition. Given the diverse backgrounds of microlearning learners in online learning communities and the incredible amount of information generated by many learning communities on today's social media platforms, it still needs to be determined how microlearning with learning communities impacts knowledge acquisition and learning experience. Therefore, this study investigates the impact of applying online learning communities in microlearning on learners' knowledge acquisition and learning experience.

Methods

Research design. This study employed a mixed-methods sequential explanatory design. This approach was driven by the objective of comprehensively understanding the impact of microlearning in online communities. It allows for an initial quantitative analysis of learning outcomes, followed by qualitative investigations to explore the dynamics behind these outcomes. First, a randomized control trial (RCT) involving 100 learners openly recruited from Chinese-language online communities was conducted to evaluate the effectiveness of community-based microlearning on knowledge acquisition and learning experiences. Semi-structured interviews were then conducted with 10 participants randomly selected from the experimental and control groups (five from each group) to elucidate their learning experiences at the end of the experiment.

Participants. We recruited a diverse group of 100 participants online for the RCT. The eligibility criteria included learners older than 18 interested in the course content. At the end of the RCT, 20 participants dropped out due to time constraints or finding that the course content needed to meet their expectations. Therefore, the data analysis was conducted on 80 participants. This group, which included 13 males and 67 females, had an average age of 24.8 years. Undergraduates accounted for 16.25%, while graduate students comprised 46.25%.

Ten participants were recruited from the 80 learners for interviews. Considering their groups, age, pre-test and post-test scores, and community preferences, five learners from the experimental group and five from the control group were selected for the interviews. Their demographic information is shown in Table 1.

Learning materials. The course design was under Gagné's (1985) learning theory. Gagné's framework identifies nine instructional events that, when effectively applied, significantly enhance the learning process. This framework was chosen for its comprehensive approach to structuring educational content, particularly its emphasis on sequencing information and providing conditions conducive to learning. By aligning the course with Gagné's principles, such as gaining attention, informing learners of objectives, stimulating recall of prior knowledge, and providing guidance for learning, we aimed to optimize the effectiveness of the microlearning modules.

Table 1 Interviewees' information.

Participants for the interviews	Gender	Age	Community preferences	Pre-test score	Post-test score	Pre-post change
<i>The experimental group</i>						
E1	Female	26	Yes	16	14	-2
E2	Female	23	Yes	8	16	+8
E3	Female	23	Yes	13	20	+7
E4	Male	33	No	13	11	-2
E5	Female	30	No	16	20	+4
<i>The control group</i>						
C1	Male	23	Yes	12	16	+4
C2	Female	25	Yes	17	16	-1
C3	Female	32	Yes	6	15	+9
C4	Female	34	Yes	14	20	+6
C5	Female	28	No	8	6	-2

The learning materials consisted of an 8-module microlearning course on conducting interviews in research studies, with 20 microlearning course videos. Each video was 3–10 min in length. The instructor appeared in the top-right corner of each video (see Fig. 1). The course content, specifically designed to explain qualitative research methods through the lens of interviews, included a comprehensive overview of the course, preparation strategies for conducting interviews, essential tools, various types of interviews, interview formats, procedural steps, and critical considerations. This curriculum aims to equip learners with a thorough understanding of conducting qualitative interviews as a research method.

Each microlearning video typically concluded with 1–3 reflection questions. Sample questions were like, "Would your interview design be better suited to using focus group interviews or in-depth interviews?" or "What types of questions are appropriate for your research project?" The reflection questions help learners review and deepen their understanding of the course content. They could also answer the questions and send their answers to the instructor (for both groups) or the community (for the experimental group only) to discuss with the instructor or community members. Learning materials were sent to each learner on WeChat as a link through a private message (for the control group) or a group message (for the experimental group). The course lasted 20 days, with one microlearning video sent to students daily. However, the instructor did not force learners to study one lesson per day on time. In other words, learners could study at any time or anywhere. If a learner did not post anything in the group or contact the instructor by private message for more than five days, i.e., no interactive behaviors, the instructor would remind them of learning via private messages.

Data collection. The experiment was conducted online in the summer of 2022. Before data collection, all participants had to sign an informed consent form detailing the study's purpose and agreeing to the use of their data. A pre-test on knowledge and a pre-course survey were conducted, with 80 participants completing both. Participants were then randomly assigned to two equal-sized groups: the experimental and the control. A balance test was conducted, and there were no significant differences between the groups in any of the variables measured in the pre-test and pre-survey.

Both groups received the same instructions from the same instructor using identical learning materials delivered over

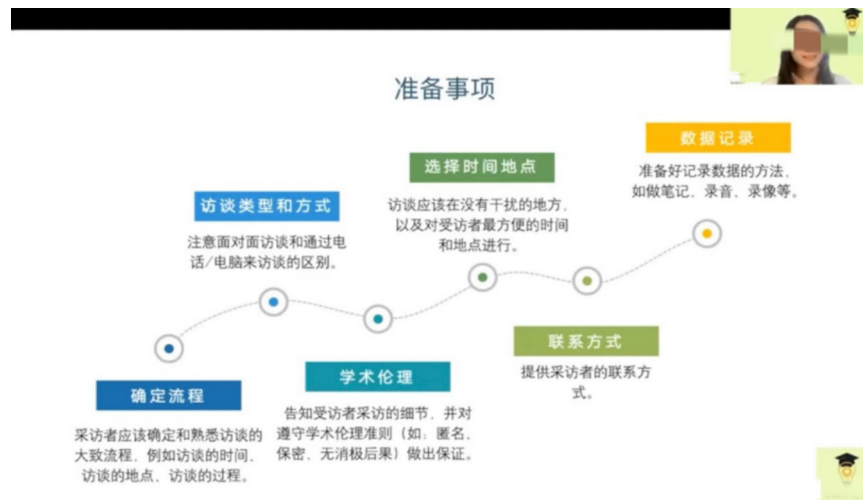


Fig. 1 Video screenshot. A screenshot of the course video.

WeChat, a mobile chat app widely used in China. For the experimental group, a WeChat group chat was created to form a learning community where regular peer interaction activities were organized. Participants voluntarily engaged in discussions within the community. In the control group, participants could interact with the instructor individually. In this RCT, participants took an 8-module course on interview research methods. After the course, 80 participants completed a knowledge test and a learning experience survey. The attrition rate was 20%, with twenty participants (10 from each group) dropping out due to time constraints.

Given the data attrition, the researcher used t-tests and non-parametric tests to explore differences between dropouts and remaining participants. Although there was data attrition, no significant differences were found between the remaining participants in the experimental and control groups in terms of gender, age, pre-test scores, and prior knowledge. Moreover, the attrition did not significantly affect the data analysis for the follow-up study. There were no significant differences between the experimental and control groups regarding gender and age, suggesting that the study did not suffer from significant attrition bias.

Tests and surveys were designed and distributed using Tencent Survey, a widely used online survey platform in China. Before the course, learners completed a pre-course survey and a pre-knowledge test. All answers to the 20 questions were covered in the course materials. The pre-course survey collected learners' demographic information, such as age, gender, and year of study. After the course, learners were given a link to complete the post-survey and post-test. The post-survey inquired about learners' learning habits, satisfaction, mental effort, and preference for learning within an online community. The post-knowledge test was identical to the pre-knowledge test. Experimental group learners who joined the community were additionally asked questions about their sense of community. Interview data were collected and recorded after the post-survey. Ten semi-structured interviews were conducted through Tencent Meeting.

Measurement methods

Knowledge acquisition variable: Knowledge test. The knowledge test consisted of 20 multiple-choice questions about interview research methods, and the content of the knowledge test in the pre-and post-test was the same. The knowledge test was designed by the researchers and examined by two experts in educational technology for content validity. A pilot test was conducted among

learners with and without previous learning experience using interview research methods. The learners with previous learning experience in interview research methods scored higher than those with no previous learning experience in interview research methods. Their feedback was used to refine the test. Scores for the pre-test and post-test were calculated on the number of correct answers in the pre-and post-tests. The total score was 20 points, respectively. The pre-test had acceptable internal consistency ($N = 100$, $KR-20 = 0.69$), and the post-test reached good internal consistency ($N = 80$, $KR-20 = 0.73$).

Learning experience variables

Satisfaction: Learners' learning experience satisfaction was measured on the post-test using a satisfaction scale adapted from Ritzhaupt et al., (2008) study. We translated it into Chinese. It is a five-point scale with 9 questions and two bipolar adjectives on both sides. For example, on the left side is the description "obscure" and on the right side is the description "clear". The satisfaction data has good internal consistency, with a Cronbach's alpha (α) equals to 0.85. The mean score of the 9 items was calculated.

Mental effort: Learners completed a 9-point scale for self-reported mental effort during multimedia learning (Paas, 1992) on the post-test. The mental effort scale ranges from "very, very low mental effort" to "very, very high mental effort". The self-reported mental effort scale was coded from 1 to 9, with higher scores indicating more mental effort required by the learners.

Sense of community: A sense of community scale, adapted from the one produced by Rovai (2002), was used to collect learners' perceptions of learning in communities on the post-test. This 5-point Likert scale contains 20 items, which were divided into two factors by Rovai (2002), i.e., connectedness and learning. The sense of community scale was coded as: for statements 1, 2, 3, 6, 7, 11, 12, 13, 15, 16, and 19, strongly agree = 4, agree = 3, neutral = 2, disagree = 1, and strongly disagree = 0. The remaining items were inverted: strongly agree = 0, agree = 1, neutral = 2, disagree = 3, and strongly disagree = 4 (Rovai, 2002). The scores of each subscale 10 items were added together, and mean scores were calculated. Learners with higher scores had more positive attitudes towards the community. Both the connectedness and learning factor in the sense of community scale had good internal consistency with Cronbach's alpha of 0.76 and 0.80, respectively. The overall course community scale had good internal consistency ($\alpha = 0.84$).

Preference for learning in a community: We also asked participants’ preferences for learning in a community. In the post-survey, we asked learners if they preferred to learn in a community after the 8-module course. Learners could express their opinions by choosing “yes” or “no”. Their answers with “yes” were coded as 1, and “no” was coded as 0.

Data analysis methods. A paired sample *t*-test was conducted to examine whether the micro-learning course was effective in enhancing learner knowledge of interview methods for all the participants. Then, to explore the impact of applying an online learning community in microlearning on learners’ knowledge acquisition, a one-way ANCOVA was conducted to examine whether there were significant differences in the post-test scores between the experimental and control groups while controlling for pre-test scores. Next, to investigate the effect of the online learning community on the learning experience, one-way ANOVA tests were conducted to analyze whether the two groups differed significantly in mental effort, preference for learning in a community, and satisfaction. Since only the experimental group had a community, there was only data from the experimental group on the sense of community. A descriptive analysis was conducted to analyze their experience and sense of community.

Interview data was transcribed in Chinese and then translated into English. We browsed the interview transcripts and extracted key information that indicated learners’ knowledge acquisition and learning experience. Then, we reviewed and reported what we found in the results.

Results

In this section, we present our findings. We used the letter + number for interview results to refer to interviewees. For example, “E1” refers to an interviewee from the experimental group, while “C2” refers to an interviewee from the control group.

Descriptive data. Table 2 shows the means and standard deviations for experimental and control group learners by gender, age, prior knowledge, pre-test, post-test, mental effort, and satisfaction. These measures were comparable between the groups. Learners who did not study in a community reported higher post-test scores but required slightly higher mental effort to complete the course.

Differences in the acquisition of knowledge. Without considering grouping, we used a paired sample *t*-test to analyze learners’ knowledge acquisition through 8-module microlearning. The result showed that the learners’ post-test scores ($M = 15.48$) were significantly higher than the pre-test

($M = 12.83$), $t(79) = 9.657$, $p < 0.001$. This suggests that the course successfully enhanced participants’ knowledge about interview methods.

A one-way ANCOVA, with the pre-test scores controlled, was conducted to examine whether having an online learning community would further enhance knowledge acquisition. Results indicated no significant difference in the post-test scores between the experimental and control groups ($F(1, 76) = 0.257$, $p = 0.614$). Joining a community had no significant effect on learners’ knowledge acquisition.

Findings from the interview data were in tandem with those from quantitative analysis. Learners who progressed through the course and those whose test scores slid existed in both groups. Interviews were used to explore further their mastery of the course content, which revealed that the inclusion of learners in a community did not have minimal effects on their mastery but that the way they learned played a more critical role. Learners who repeatedly studied the microlearning content and took notes during the learning process usually had higher post-test scores than pre-test scores. For example, E3, who scored 13 points on the pre-test, took notes using her iPad and scored 20 points on the post-test. Moreover, C4 mentioned that she took notes in her notebook as she watched the video. If she forgot some learning points, she would go back and watch the learning content again. C4 got 14 points on the pre-test but scored 20 points on the post-test. During the interviews, they reported that they could clearly recall the content of each module. For instance, E3 said, “Sometimes the instructor would ask us in the video if we remembered the content mentioned in the previous course. If I did not remember the content, I would immediately find the previous course video to make sure I remembered it.” C4 said, “I would find a quiet time to watch the microlearning videos without interruptions and record the content of the lessons. In this way, I could open my notes for review during the weeks.”

Other learners reported that in the learning process, they studied repeatedly to practice what they learned and searched information online for what they did not understand. For example, C1 shared an experience:

During the microlearning course, I happened to need to use the interview research method. So, I used interview methods over and over again to collect the data I needed. The course really helped me a lot..... When I encountered something I could not understand, I would go to literature and collect more information online, so I could successfully collect the interview data.

Learners whose post-test scores were lower than their pre-test scores indicated in the interviews that they might not listen well enough during online microlearning. When asked what they remembered about the course content, they only gave the general course framework or remembered only the content of a particular module that the instructor repeatedly emphasized. For instance, E1 admitted, “Sorry, I do not really remember exactly what I learned; I just remember that the instructor focused on the steps of the interview research method and that the teacher said it many times.”

Differences in the learning experience. Learning experiences in this study included the levels of mental effort that learners believed they needed to invest in the 8-module course, their preferences for learning in a community, and their satisfaction with the learning process. One-way ANOVA was conducted to determine whether the groups had significant differences regarding their learning experience. Experimental group learners who studied in the community also reported their sense of community in the post-survey.

Table 2 Descriptive data of mean and standard deviation for each variable between two groups.

	Experimental group (N = 40) Mean (SD)	Control group (N = 40) Mean (SD)
Gender	0.80 (0.41)	0.88 (0.34)
Age	24.83 (4.46)	25.48 (4.04)
Prior knowledge	2.33 (0.83)	2.08 (0.80)
Pre-test	12.48 (2.72)	13.18 (2.60)
Post-test	15.25 (3.00)	15.70 (2.51)
Mental effort	4.38 (1.60)	4.55 (1.69)
Satisfaction	4.01 (0.61)	4.08 (0.47)

Table 3 ANOVA results in learning experience between two groups.

	Experimental group (N = 40) Mean (SD)	Control group (N = 40) Mean (SD)	F	p
Mental effort	4.38 (1.60)	4.55 (1.69)	0.226	0.636
Preference of learning in a community	0.57 (0.50)	0.82 (0.38)	6.270	0.014*
Satisfaction	4.01 (0.61)	4.08 (0.47)	0.297	0.587

*p < 0.05.

Mental effort. Though the descriptive data showed that learners from the control group ($M = 4.55$) required slightly more mental effort than learners from the experimental group ($M = 4.38$), there was no significant difference between the two groups according to one-way ANOVA results on their self-reported mental effort score, $F(1,78) = 0.226$, $p = 0.636$ (see Table 3).

Both groups of learners indicated in the interviews that the microlearning content was relatively easy. Learner E5 said, “The microlearning lessons were all relatively short in length, no more than 10 min, as I remember. The instructor sent us one lesson per day, so I did not need to spend much effort to complete the course.” Learner C4 also said, “The microlearning videos were shorter, and I could keep track of learning on my own; therefore, I sometimes accumulated a few days of learning content together.” She said that she liked this self-directed learning process. Learner E2 noted, “I checked the community information to see what my peers were discussing to deepen my understanding of the course content.”

Community preferences. Interestingly, there was a significant difference between the experimental and control group learners on their community preferences, $F(1,78) = 6.27$, $p = 0.01$ (see Table 3). Based on the descriptive data, learners who did not join a community ($M = 0.82$) were more likely to prefer having a learning community than learners in a community ($M = 0.57$).

Through the interviews, we found that learners had too many chat groups (learning communities) on WeChat, where they received hundreds of community messages every day, resulting in their ignoring the information. Learners in the experimental group mentioned that they did not check the community messages daily. They only skimmed through the information and may not have made much of an impression. Learner E4 said, “I took time out of my busy day to study the microlearning course. Since there are so many group messages, I often choose to mute them so that I am not disturbed by too many messages. But this may also lead to me missing much information.” Besides, some learners in the experimental group reported that community learning enabled them to enhance learning. Learner E1 said, “Sometimes there were learners in the group who asked questions that happened to be confusing to me as well, and I think it is very rewarding to learn in a community.”

Moreover, learners in the control group were often excited about community learning, even though they did not join the community during the experiment. Learner C3 told us, “I think I would have learned more if there had been a community.” However, when asked if they would choose to interact in a community if they had joined a community at the beginning of the course, many of the control group learners indicated that they probably would not have. Learner C2 explained, “I prefer to watch others speak, but I would probably not choose to speak in a community.” Learner C4 also noted, “I would be more apprehensive about speaking in public when there are many learners in a community. I am afraid of saying the wrong things.” Of course, not every learner from the control group would like to learn in a community. Learner C5 refused to learn in a

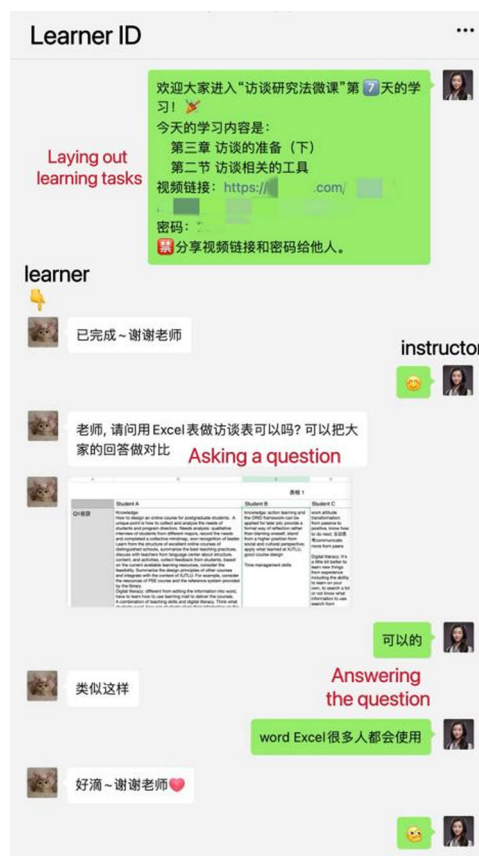


Fig. 2 Interaction between a learner and the instructor. A screenshot of private messages between a learner and the instructor.

community and thought that she would most likely not check the group messages often. She believed that the important thing about microlearning for her was understanding the course content and that the discussion part was not essential to her.

Satisfaction. We found no significant difference between the experimental and control groups on their satisfaction scores, $F(1,78) = 0.297$, $p = 0.587$ (see Table 3). Based on the descriptive data, learners who did not join a community ($M = 4.08$) and those who were in a community ($M = 4.01$) were similar in terms of satisfaction.

Both groups expressed high satisfaction with the microlearning course. They perceived that the microlearning content was easy to understand, the course content was useful, and the instructor would help them during the learning process. Learners in the control group mentioned that the daily private messages from the instructor made them feel valued (see Fig. 2). Learner C1 said, “I always felt like the instructor I received messages from every day was a robot until one day I asked a question, and the instructor answered it patiently. I was so excited that I communicated more

Table 4 Mean and standard deviation of learners' sense of community in the experimental group.

	Mean	Standard deviation
Course community scale in general (20 items)	51.95	10.09
Subscale-connectedness	24.50	5.57
Subscale-learning	27.45	6.34

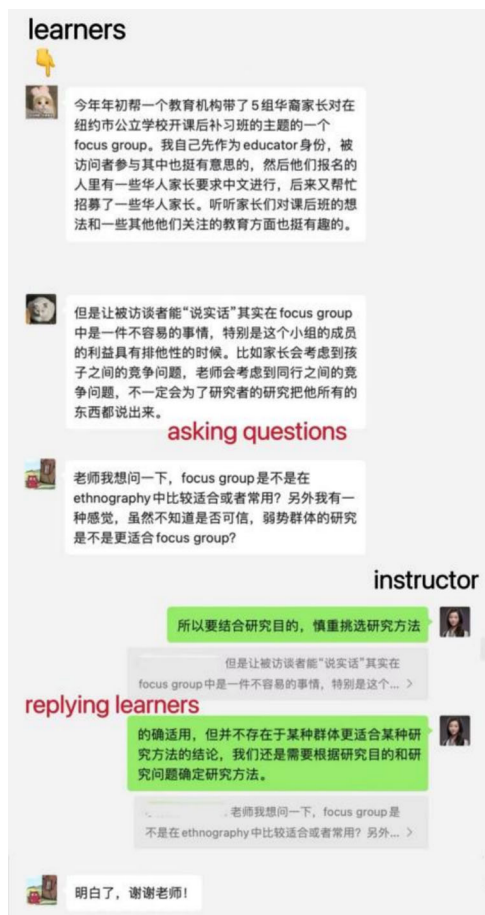


Fig. 3 Community discussions. A screenshot of discussions in the community.

with my instructor since that day.” Some learners in the experimental group reported that learning in a community positively impacted their learning experience. Learner E1 mentioned that she learned a lot from examples shared by other more experienced learners in the community; “They were like course assistants. Reading the messages about their experiences related to interviews helped me understand the interview research method.”

Sense of community. Forty learners in the experimental group reported their sense of community in the post-survey. Table 4 reports the mean and standard deviation of their sense of community scores.

Community learners who made significant progress in their performance mentioned that they enjoyed learning in the community. Communication in the community helped them better understand the learning materials, and the community provided good opportunities for them to learn comfortably (see Fig. 3). “I think sometimes other learners’ questions were also my

questions. It made me happy to see the questions being answered in the community,” said E2. E3 explained, “I was able to see the perspective of my peers thinking through their responses. When they answered the same question from different angles, I was able to think about the same question from various perspectives. It is interesting.” E2 and E5 mentioned that by checking the community messages, they were able to discover some points they had overlooked in the study process, which helped them fill in the knowledge gaps. At the same time, E2 also raised the problem of missing information due to the large number of WeChat community messages and hoped that the managers or instructors could provide collated key information.

However, some learners did not check the community messages very often, and their test scores dropped. For instance, E4 said, “I do not think the presence of a community has much impact on me, and I do not really read the group messages anyway. Sometimes, too many group messages are a nuisance to me.” E1, when asked if she checked community messages, said, “I have so many communities with too much information to read that I usually muted them. But this also caused me to sometimes forget to check the group messages and miss the key information.” At the same time, she also mentioned that even if she checked the group messages, she did not remember any key information. She had not posted anything nor connected with anyone in the community.

Discussion

In this study, we examined the effectiveness of community-based microlearning on knowledge acquisition and learning experiences. In particular, we engaged 80 learners, 40 of whom were in the community and another 40 who were not. This section revisits the research question with two aspects, knowledge acquisition, and learning experience, and discusses the implications.

Knowledge acquisition. The majority of participants in this study demonstrated significant improvements in learning performance through microlearning. This finding is consistent with the existing microlearning research that has reported increased knowledge (Lee et al., 2021). The concise format of microlearning effectively breaks down complex content into digestible chunks, facilitating clearer and easier comprehension. This also makes it easier for learners to grasp the main points. Microlearning has been recognized as a potent instructional approach or intervention across various educational contexts, including higher education (online, hybrid, and blended courses), corporate training, and professional development for K-12 teachers (Sankaranarayanan et al., 2023). Using microlearning as an intervention is crucial because it provides a focused, efficient, and adaptable learning experience tailored to the unique needs of learners in these diverse settings. Yet, the presence of a learning community did not significantly influence knowledge acquisition among learners. This contrasts the findings of Jiménez-Zarco et al. (2015), who found that learning in a community improved learners’ learning performance. This outcome may stem from the inherent characteristics of microlearning itself. Jiménez-Zarco et al. (2015) did not provide specific learning materials; learners joined a virtual community of practice to obtain the information they needed selectively. In contrast, our study provided learning materials and aimed to help learners master the basic knowledge points of interview research methods through micro-lessons. While learners might prefer a more relaxed and informal learning setting, it could result in a less serious engagement with microlearning content. Disengaged learning combined with too much online information may disrupt learners’ receptivity to the information.

This is also similar to Lu et al. (2019) findings, which reported that overwhelming information in the online environment sometimes hinders learners' recognition in response to online information.

Interview data revealed the seriousness with which learners approached the course content, and their learning choices significantly impacted knowledge acquisition. When learners listened carefully, took notes, and selectively played back course content, they were able actually to remember more information and receive higher test scores. Kauffman et al. (2011) found that learners with high self-monitoring prompts used matrix note-taking devices and improved learning achievement in online learning environments. In addition, playing back the course video means reviewing the learning content, which could help learners deepen their impression of the knowledge points and thus achieve higher test scores. Instructors can encourage note-taking during microlearning sessions and assist learners in reviewing content to enhance retention.

Learning experience. Despite the lack of a statistically significant difference in mental effort between groups, descriptive data indicated that community participants expended marginally less effort to complete the course compared to their non-community counterparts, perhaps because the community dissolved the cognitive load that would otherwise have to be undertaken by each learner in the experimental group. Jung et al. (2015) supported this finding that under low cognitive load conditions, an individual can adequately process activities, and learning collaboratively may generate the costs of recombination and coordination. Microlearning requires low mental effort because it is concise. Therefore, the mental effort required in microlearning is low, so whether or not learners were in a community did not significantly affect mental effort.

There was no significant difference in learning satisfaction between the two groups of learners, with most expressing satisfaction with the microlearning process. However, learners who completed the post-test demonstrated higher course satisfaction, while those who were less satisfied may have discontinued their participation earlier. Angelino et al. (2007) noted that online learning had higher dropout rates, ranging from 10 to 20 percent. Unlike traditional learning classes, learners engage in spontaneous learning in informal and non-formal settings. The microlearning activities they participated in gave them greater autonomy (Kohnke et al., 2024), making them more likely to discontinue learning when they encountered problems with time limits or when the content did not meet their expectations. This finding provides insight to community managers and micro-course educators that creating a community does not mean that learners will be more satisfied and that it is important to explore how to use course design to retain learners.

We found that learners who were not in a community were eager to learn in a community, but learners who were in a community might ignore or choose to mute community messages. As mentioned by Lu et al. (2019) and Kumar et al. (2023), for learners, too much information in the online environment may have a negative impact on learning. Chane et al. (2022) also noted that students preferred to receive personal attention from the teachers. In our study, the instructor sent private messages to the control group learners, and those who received the instructor's private messages might be able to get noticed; in contrast, learners in the experimental group might miss the instructor's public message sent to the entire community if they chose to mute the community message reminder and thus were unable to feel the instructor's attention to them. Although learners in the control groups expressed the urge to join a

community, they also received additional personal attention from the instructor. Although learners in the control group without learning communities wished to have an opportunity to communicate with others, they also expressed uncertainty when asked if they would post in an online community. Whether or not they would post in a community is influenced by many factors. A large number of messages already in the communities may cause learners to be reluctant to post in the community (Nguyen, 2021; Nonnecke et al., 2006). Beaudoin (2002) also noted that learners were often apprehensive about speaking in public. When they were unsure that their responses were helpful, they usually chose not to post.

Community learners' sense of community may be polarized. Learners who were actively engaged in community learning and had improved their test scores enjoyed their learning in the community. They were able to learn about the perspectives of their peers from the community information, which helped them fill in the knowledge gaps (Schreurs, 2014). For learners who did not check the community information frequently or even mentioned in the interview that they did not need the community, they often chose to mute the community and received lower test scores. The community information may cause information overload for them. Kuo et al. (2017) also supported this finding. They found that the sense of community and perceived collaborative learning contributed significantly to learning, and most students in the groups had a positive sense of community. Moreover, Speily and Kardan (2018) mentioned that learners in online learning communities had different backgrounds, which might result in information not being applicable to all learners and learners being reluctant to share in the community. This is one of the reasons why some of the interviewees mentioned that they were reluctant to post in a community when the community is large and lacks connections. If group members are familiar with each other, they may find it easier to communicate within the group. High familiarity could contribute to online collaboration and give group members a more positive sense of community (Janssen et al., 2009). This suggests that community managers and educators should consider forming multiple small groups based on learners' backgrounds to foster a more cohesive and supportive online learning environment. Kohnke et al. (2024) emphasized the importance of enhancing interactions in microlearning activities, suggesting that learners can feel more connected and engaged by improving the quality and frequency of these interactions. This helps to reduce the number of learners in each community, create communities with closer relationships, and promote community members to post in the community and gain a more positive sense of community (Speily and Kardan, 2018).

During the interviews, some learners expressed a desire to summarize and organize the information in the community into a document so that everyone could review the messages that had been discussed. In their study, Yang et al. (2004) indicated that creating a document through collaboration could motivate learners to share knowledge in an online learning community, help them sort out the relationships between knowledge points, and contribute to knowledge acquisition. This is also a good suggestion for microlearning designers and educators. Especially in social media-based microlearning, learners are often distracted by redundant information. Providing collaborative documents and encouraging learners to edit and contribute may motivate them to engage better in microlearning, facilitate tracking their learning progress, and keep them from missing out on important community discussions.

In light of these findings, it becomes imperative for course designers to meticulously consider the composition and management of online learning communities to optimize learner

knowledge acquisition and learning experience. Specifically, designing the format of microlearning that is responsive to the learners' feedback and preferences, as uncovered in our qualitative insights, can significantly enrich the learning experience. For researchers, these results highlight the critical need for further exploration into the effective integration of community features within microlearning environments. This study, therefore, not only contributes to the existing body of knowledge by providing empirical evidence on the efficacy of online learning communities in microlearning settings but also paves the way for future research to explore educational designs that cater to the evolving needs of learners.

Limitations and future studies

Some limitations of this study are listed as follows: First, the number of learners who participated was relatively limited. The attrition rate of the RCT was 20%. Future research could use the same learning materials designed for this study to recruit more learners and validate the experimental findings. Researchers could also take measures to prevent attrition and conduct sensitivity analysis after attrition. Second, we did not include questions about how learners chose to learn, such as whether they took notes during learning and re-played the study videos in our post-survey design. Future studies could include these questions in the experimental design to find evidence of what we found in the interview data. Third, learners were required to complete the post-test immediately after the 8-module microlearning course. Future studies can implement several tests during and long after the course to understand the changes in learners' knowledge acquisition.

Conclusion

Microlearning, the latest lifelong learning trend, has attracted the public's attention. Although many studies have been done on microlearning, researchers lack empirical findings on the impact of online learning communities on microlearning learners regarding knowledge acquisition and learning experience. Through its empirical exploration, this study illuminates the nuanced role of online learning communities in enhancing microlearning, focusing on knowledge acquisition and the learner's experience. The conclusions of this study underline critical implications for educators, researchers, and microlearning designers, underscoring the paramount importance of delivering personalized learning experiences in the design of microlearning courses. It highlights the necessity of preemptively gathering data on learners' preferences and their informational absorption capacity to tailor the micro-courses effectively. Furthermore, the study advises against overcrowding online learning communities, suggesting instead that community managers should foster interactive opportunities and prevent excessive lurking by learners. Significantly, the findings caution that providing online learning communities does not automatically enhance the learning experience. There is a vital need for a focused approach to providing personalized microlearning features, ensuring they align with individual learner profiles. This expanded understanding not only enriches the learning experience but also marks a significant stride in optimizing the efficacy of online learning environments through targeted, learner-centered strategies.

Data availability

Data will be made available from the corresponding author upon reasonable request.

Received: 4 August 2023; Accepted: 5 September 2024;

Published online: 13 September 2024

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Acknowledgements

We would like to thank the research participants who generously agreed to participate in this study and share their time and experience. This work is supported by the Chenguang Program of Shanghai Education Development Foundation and Shanghai Municipal Education Commission and the Peak Discipline Construction Project of Education at East China Normal University.

Author contributions

J.Z.: corresponding author; conceptualization, data collection and analysis, writing, and editing. H.H.: data collection, methodology, review, and editing. Y.Z.: methodology, review, and editing. M.C.: microlearning course design.

Competing interests

The authors declare no competing interests.

Ethical approval

Approval was obtained from the ethics committee of East China Normal University (HR074-2020). The procedures used in this study adhere to the tenets of the Declaration of Helsinki.

Informed Consent

Informed consent was obtained from individual participants before the summer of 2022 ended. All the participants are older than 18.

Additional information

Correspondence and requests for materials should be addressed to Jiawen Zhu.

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