



A Study of Preferred Learning Time of Online Learner in Multimedia Microlearning in Higher Education Context

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Abstract: This study aims to explore “when would online learners prefer to interact with multimedia microlearning” in higher education context. Although microlearning is an emerging topic, most of the previous studies were focus on reporting the application results of microlearning, only very few of previous works were specifically conducted on discussing when would online learners prefer to interact with multimedia microlearning. An online questionnaire was used to collect learners’ preference on video-based multimedia microlearning. In total, 77 respondents attempted the survey, the response rate is 32.6%. The findings from this study indicate that more learners prefer to study during morning or afternoon rather than evening or midnight time (H2) ($p < 0.05$). On the other hand, there is no significant difference on when to attempt assessment (H1) and on gender issue (H3, H4). To conclude, assessment for microlearning video can be arranged during the video or after the video, learners prefer learning during daytime and gender does not make significance difference on such preferences. The findings from this study generates knowledge to fill the research gap in the field of microlearning. According to the researcher’s best knowledge, this is the first time that a study like this had been conducted to review and discuss the online learners’ preferences on interacting multimedia microlearning. Hopefully, this study could shed some lights on future directions of the development of microlearning.

Keywords: microlearning, online learning, e-learning, digital learning, learning time, multimedia learning, preference

1. Introduction

This study aims to explore when would online learners prefer to interact with multimedia microlearning in higher education context. In practice, there are many concepts and versions of microlearning (Downes, 2005; Hug, 2005b; Leong et al., 2021; Mayer & Pilegard, 2014). However, the principles of microlearning include short learning time, short-term-focused activities and relatively small learning contents (Hug, 2005a).

Microlearning is an emerging topic in business education and training. According to Emerson and Berge (2018), microlearning facilitates acquisition of knowledge in the workplace through motivating and engaging staffs to communicate and apply what they have learned. On the other hand, Hesse et al. (2019) suggest that microlearning is effective in improving the feelings of confidence and accuracy in work.

In summary, the key benefits of using microlearning include (1) better retention of concepts (Giurgiu, 2017; Shail, 2019), (2) better engagement for learners (Jennie Chang De Gagne et al., 2019; De Gagne, Woodward, Park, Sun, & Yamane, 2019; Liao & Zhu, 2012; Nikou, 2019), (3) improving learners' motivation (Halbach & Solheim, 2018; Nikou & Economides, 2018; Shail, 2019; Stronck, 1983), (4) engaging in collaborative learning (Chang & Liu, 2015; Reinhardt & Susan, 2019; Zhang & Ren, 2011) and (5) improving learning ability and performance (Jomah, Masoud, Kishore, & Aurelia, 2016; Mohammed, Wakil, & Nawroly, 2018, Sung et al., 2020).

Although many previous works had reported the benefits of microlearning application, only very few of previous works were specifically on discussing when would online learners prefer to interact with multimedia microlearning. The knowledge of relevant time preference would help to achieve more effective multimedia microlearning design and implementation. Therefore, this study aims to fill the knowledge gap and to provide a reference for practitioners, researchers, and policy makers for possible future research and debates.

More specifically, two types of learners' preferences are explored in this study, they are i) when the learners prefer to attempt assessment and ii) what is the preferred time for learning online among learners. In addition, we are interested to evaluate whether gender difference is found in the above preferences.

The remainder of this paper is organized as follows. Section 2 comprehensively reviews the relevant research on preferred learning time and gender difference in learning. Section 3 explains the research methodology in this study. Data presentation, analysis and findings are reported in section 4. Section 5 is the conclusions and recommendations of this study.

2. Literature Review

This literature review consists of two main parts: i) preferred learning time and ii) gender difference in learning. Four hypotheses were proposed accordingly.

2.1 Preferred Learning Time

Time is a fundamental variable in human biology and also in learning (Kelley, Lockley, Foster, & Kelley, 2015). Gettinger and Seibert (2002) suggested that the interest in learners' learning time can be traced back to the 60's. Stallings (1980) indicated that one of the most useful variables to emerge from the research on teaching during the 1970's was learner time spent on learning.

However, analysing learning time is inherently complex because temporal data can be presented and organised at different levels of measurement such as seconds, minutes, days, weeks, months, years and other means. Moreover, different levels of temporal measurement can also be associated with different relationships, such as duration and interval, etc. In brief, according to previous learning related studies, the temporal pattern analysis can be classified into three major types, they are: i) amount of time (Aronson, Zimmerman, & Carlos, 1999), ii) preferred time (Rita Dunn, Dunn, Primavera, Sinatra, & Virostko, 1987) and iii) time allotment (Cotton & Wiklund, 1990).

This study focuses on preferred time. Preferred time is a type of temporal pattern that has widely been studied in learning-related studies. For example, Callan (1998) found that learners understand the material better and perform better on tests at their preferred time of day. Rita Dunn et al. (1987) reported time preference was a crucial factor in the reversal of initial and chronic truancy patterns among secondary students. Kelley et al. (2015) found that altering education times can improve learning for adolescence. Moreover, the findings from Kahlaoui (2019) indicated that there is a strong correlation between time of day and students' academic performance for different age groups. In addition, previous studies (Wahistrom, 2002; Wahlstrom et al., 1997) also reported the change of school start times significantly improve students' behaviour, including a reduction in disciplinary problems.

According to existing research, the findings of preferred learning time were mixed. Some studies suggested that effective learning takes place earlier in the day. In a study (Beşoluk, Önder, & Deveci, 2011) on Turkey's University students, it was reported that students who attended the morning sessions (08:00-14:50) achieved higher scores than those with later sessions (15:00-21:50). Pope (2016) also found that having a morning instead of afternoon Maths or English class increased a student's GPA by 0.072 and 0.032 respectively. It was found in a study (Onyper, Thacher, Gilbert, & Gradess, 2012) that grades were somewhat lower for students with predominantly late class schedules.

On the other hand, some different results have been reported. R Dunn (1998) suggested that only a small proportion of students learn well in early classes or perform well on tests administered in the early morning. In another study, Li, Gray, and Verspoor (2017) found that evening was a time more popular than morning or afternoon among learners; some participants of the study were online after midnight, or very early in the morning. In a Japanese students' study, Wang, Iwata, and Jarrell (2018) found that evening and night were the most favoured times for receiving learning materials on digital devices, while the afternoon is ranked as the least desirable time.

Given previous studies have found that learners would have their preferred learning times, this is expected that preferred learning time pattern should be existed among the learners of this study. Accordingly, hypotheses are proposed as:

- H1: Learners would have preferred time to attempt session's assessment when they attend session
 H2: Learners would have preferred time for learning online

2.2 Gender Difference in Learning

Previous studies have suggested that there are gender differences found in learners' learning in different aspects. For example, it is reported that females are less preferred abstract conceptualisation mode of learning than males (Severiens & Ten Dam, 1994). In another study (Wu & Cheng, 2019) reported that males show higher perceived attention problem than females in learning. Bidjerano (2005) concluded that gender difference found in terms of using self-regulated learning strategies in their learning. Pöhl and Bogner (2012) took the effect of gender on instructional efficiency into consideration and found the young females achieving significantly higher long-term learning success than young males. It is also found that the spatial ability differs between genders (Astur, Tropp, Sava, Constable, & Markus, 2004; Uttal et al., 2013).

Many previous studies have also reported the gender difference in e-learning and online learning context. For example, Tarhini, Hone, and Liu (2014) concluded there are gender differences in learners' learning performance in e-learning environment. Price (2006) describes online female learners are confident independent learners and outperform than male learners. Garland and Martin (2005) concluded the difference of learning style between online learners and face-to-face course while gender is a factor behind the difference. McSporrán and Young (2001) developed an online course and found female learners are more motivated and better at scheduling their learning. Roy and Chi (2003) suggested that female learners and male learners demonstrate different patterns of searching the web. According to the findings from David Passig and Levin (2001), boys who are more familiar with computer games demonstrate a higher level of satisfaction in learning than girls. On the other hands, when animation, narration and text are effectively combined, female learners have a higher maintained situational interest (Dousay & Trujillo, 2019). D. Passig and Levin (2000) suggested that the level of satisfaction between females and males depends on the design of the online learning interfaces.

However, it is also worth noting that the findings of gender difference in learning are not consistent across previous studies. For example, Barrett and Lally (1999) reported that on average, males send more messages than females in formal online learning environment. On another hand, it was found that males and females participate and contribute differently in computer mediated communication and females posted and read message more frequently than males (Gunn, McSporrán, Macleod, & French, 2003). Another example is about learning benefits, Saha and Halder (2016) reported that male students demonstrate a greater learning benefits associated with animated resources but Coward, Crooks, Flores, and Dao (2012) reported a contrary view. On the other hand, with an focus on millennials, Harvey, Parahoo, and Santally (2017) suggested there are no significant differences between genders in learning.

Given there are potential influence of gender on preference in learning, a further investigation was conducted in order to evaluate whether the hypotheses 1 to 2 discussed in above would be affected by gender difference. Accordingly, two hypotheses are proposed as:

- H3: Gender difference exists among learners in terms of their preferred time to attempt session's assessment when they attend session
 H4: Gender difference exists among learners in terms of their preferred time for learning online.

3. Methodology

The primary data of this study were collected from the learners of selected three modules who enrolled in the academic year September 2020 to May 21. More specifically, the three modules are sitting under two business programmes of a public University in U.K. through two full time programmes, they are: a) BSc Accounting and Finance and b) MSc Management. The whole population of this study are all the learners who enrolled in these three modules.

Given the population size is relatively small and all learners (i.e. potential respondents) are reachable in manageable efforts, therefore this study used the total population sampling technique for collecting data from the population.

Questionnaire was selected as data collection tool in this study. This research took place online and Microsoft Forms (MS Forms) is used as the platform of the questionnaire. A pilot questionnaire was developed to collected feedback from colleague and selected student representatives about the questionnaire.

All potential respondents were contacted directly by the researchers through their learners' emails. More specifically, the email contains the web link of the questionnaire. Other than the web link, the email also briefs the purpose and background of the research, instructions of the questionnaire. Learners also be reminded that participation to this research is voluntary in order to minimise their pressure to answer the questionnaire. Moreover, learners had been told that they could participate any time at their own convenience.

The collected data from MS Forms were analysed by MS Excel (version 2016 for Windows) and SPSS (version 26 for Windows).

The questionnaire was designed building on the data requirements of the 4 proposed hypotheses. In terms of the structure, the questionnaire consists of two major parts. The first part is a participant information and consent form. In the second part of the questionnaire, corresponding questions were designed according to the 4 proposed hypotheses as below:

For hypothesis 1 (H1), the relevant question provides a scenario to respondents that when they are given a 5 to 10 minutes education video and the video contains a few questions, how they like the questions would be arranged. There are two options for respondents to choose: i) questions to be asked at the end of the video and ii) questions to be asked during the video.

For hypothesis 2 (H2), in the relevant question, respondents are provided with 4 options of preferred time for online learning (i.e. 6am to 12 pm, 12pm to 6pm, 6pm to 12pm and 12am to 6am).

For hypotheses 3 and 4 (H3, H4), there is a question which is about the gender of the respondents. The data collected from this question help to create different gender groups and support the evaluation of hypotheses 3 and 4 (H3, H4).

4. Result and Discussion

This section reports the findings based on an online survey by means of online questionnaire conducted during 18 February to 4 March 2021 (2 weeks).

Learners from the 3 selected modules were invited to participate the survey. In total, the survey’s invitation had been sent to 236 learners through emails, which is the total population for the 3 selected modules. 77 respondents completed the survey, the response rate is 32.6%.

- Characteristics of the population

In total, the population consists of 236 learners. These learners come from the three target modules, including two undergraduate modules and one postgraduate module. Among the population, Table 1 illustrates that 134 targeted learners (57%) are postgraduate (PG) learners and 102 learners (43%) are undergraduate (UG) learners. On the other hand, 105 targeted learners (44%) are female learners and 131 learners (56%) are male. Given total population sampling is adopted in this study, all the 236 learners had been invited to attempt the questionnaire. In total, 77 learners responded, response rate is 32.6%.

Table 1 - Comparison among the characteristics of population and sample

Item	Population (f)	Respondents (f)
Level of study		
- Undergraduate (UG)	102 (43%)	34 (44%)
- Postgraduate (PG)	134 (57%)	43 (56%)
Gender		
- Female	105 (44%)	36 (47%)
- Male	131 (56%)	41 (53%)

- Characteristics of respondents

Among the respondents, there are 43 postgraduate (56%) and 34 undergraduate (44%) as per table 1. In addition, the respondents consist of more male respondents (41 respondents, 53%) than female respondents (36 respondents, 47%). In brief, both patterns are in line with the total population in terms of i) there are more postgraduate learners than undergraduate learners as per above figure 1 and ii) male learners (56%) are more than female learners (44%).

4.1 Descriptive Analysis of the Preferred Interaction Among the Respondents

This section reports the findings of the preferred interactions among respondents.

- The preference of when to attempt assessment (H1)

Given a scenario that respondents are attending a 5 to 10 minutes education video, respondents had been asked about how they would like the questions be arranged. Figure 1, shows that more respondents (42 or 55%) prefer the questions to be asked during the video rather than after the video (35 or 45%).

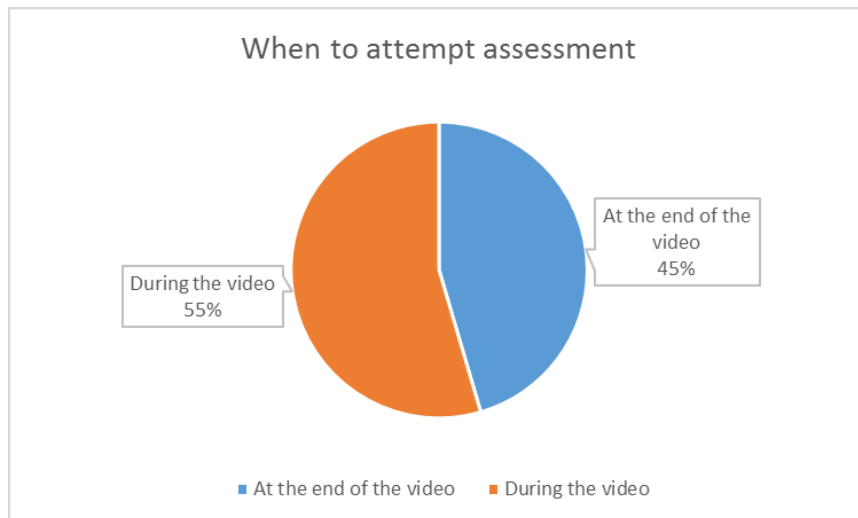


Fig. 1 - The preference of when to attempt assessment

- The preferred time for learning online (H2)

At then another question, respondents were invited to choose a preferred time for online learning from 4 options (i.e. 6am to12 pm, 12pm to 6pm, 6pm to 12pm and 12am to 6am). As per the results shown in Figure 2, 41 (53.2) respondents prefer to study online during morning time (i.e.6am to 12pm (noon)), 33 (42.9%) respondents prefer to study online during afternoon time (i.e. 12pm (noon) to 6pm), and reminding 3 (3.9%) respondents prefer to study online during evening time (i.e.6pm to 12am). The results indicate that respondents prefer to study during morning or afternoon time rather than evening or midnight time.

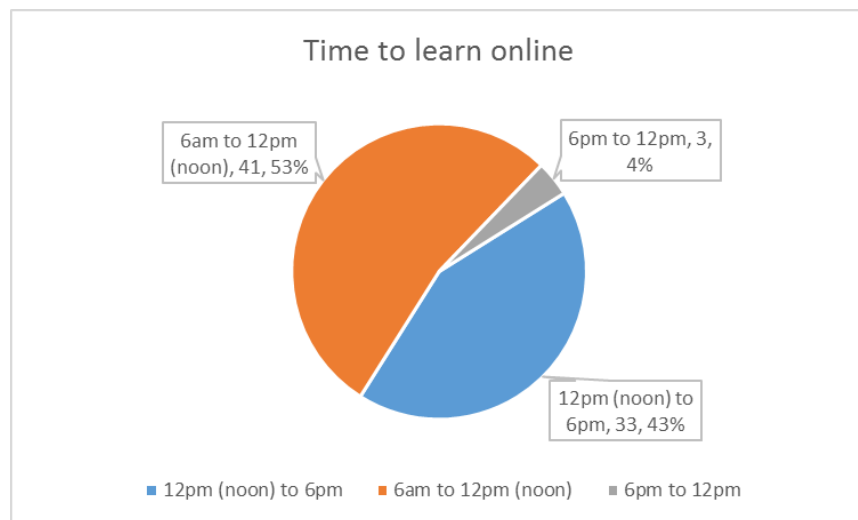


Fig. 2 - The preferred time for learning online

4.2 Significance tests of the preferred interactions

Significance tests were conducted to evaluate if the findings reported in above section related to hypotheses 1 to 2 are statistical significance.

- Significance test for hypothesis 1 (preference of when to attempt assessment)

Result reported in previous section indicates that more respondents prefer the questions to be asked during the video rather than after the video in an assumed multimedia microlearning context. The result is in line with hypothesis 1 (H1), that is, learners would have preferred time to attempt session’s assessment when they attend session.

One-sample Chi-Square test was conducted by using SPSS v.26 to examine whether the result is statistical significance or not. As per Table 2, by comparing with expected distribution of the choice occurs with equal probabilities, the observed choice is not supported ($p < 0.05$). Therefore, the null hypothesis 1 is not rejected. Accordingly, conclusion can’t be made in terms of whether learners have preference preferred time to attempt session’s assessment when they attend session.

Table 2 - Summary of hypothesis 5 testing using Chi-square test on respondents' preference on when to attempt assessment

Null Hypothesis	Test	Sig.	Decision
The categories of questions be arranged occur with equal probabilities	One-Sample Chi-Square Test	.425	Retain the null hypothesis

The significance level is .05.

Although previous study (Kelley et al., 2015) indicated that time is a key variable in learning related studies, the significant test for hypotheses 1 found that there are no evidence to show learner have preferred time to attempt session's assessment when they attend session. This is possible because of microlearning involves short learning duration time, therefore, when to attempt the assessments are not a concern for learners.

- Significance test for hypothesis 2 (preferred time for learning online)

Result reported in previous section indicates that more respondents prefer to study during morning or afternoon time rather than evening or midnight time. The result is in line with hypothesis 2 (H2), that is, learners would have preferred time for learning online.

One-sample Chi-Square test was conducted by using SPSS v.26 to examine whether the result is statistical significance or not. As per Table 3, by comparing with expected distribution of the choice occurs with equal probabilities, the observed choice is supported ($p < 0.05$). Therefore, the null hypothesis 2 is rejected. Accordingly, it concludes that learners would have preferred time for learning online.

Table 3 - Summary of hypothesis 2 testing using Chi-square test on respondents' preference on preferred learning time.

Null Hypothesis	Test	Sig.	Decision
The categories of Preferred learning time occur with equal probabilities	One-Sample Chi-Square Test	.000	Reject the null hypothesis

The significance level is .05.

The findings and significance test for hypothesis 2 suggest that there is a preferred time among learners' for online learning and the findings are in line with previous studies (Beşoluk et al., 2011; R Dunn, 1998). These previous studies also indicate that learners prefer morning or afternoon sessions in their learning.

4.3 Analysing the Gender Difference of the Learners' Preference

Further analyses were conducted to evaluate the gender difference of the preferred interactions among respondents.

- Gender difference on the preference of when to attempt assessment (H3)

The results by gender from the respondents on their preference of when to attempt assessment are shown in the bar charts as per Figure 3.

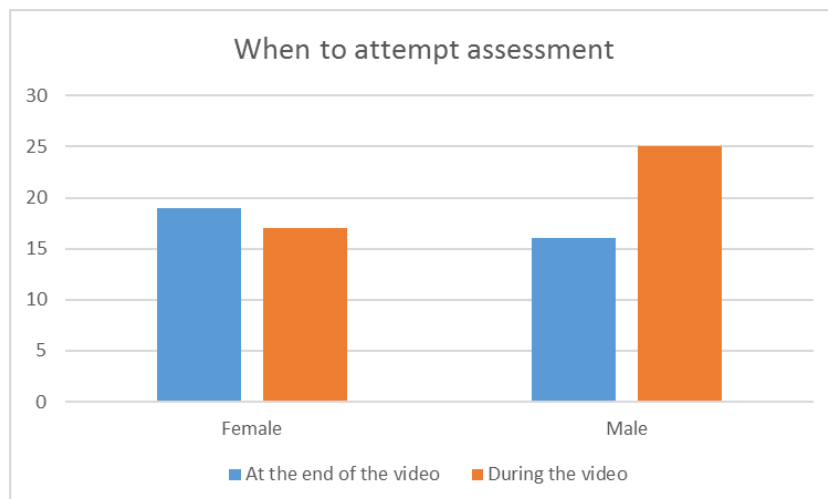


Fig. 3 - Count of when to attempt assessment by gender

Chi-Square test was conducted by using SPSS v.26 to examine statistical significance for gender difference exist or not. As per the Table 4, the difference is not supported ($p < 0.05$).

Table 4 - Summary of Chi-square test on respondents' preference on when to attempt assessment by gender

		Gender			
		Female	Male	Total	
Questions be arranged	Questions to be asked at the end of the video	Count	19	16	35
		Expected Count	16.4	18.6	35.0
	Questions to be asked during the video	Count	17	25	42
		Expected Count	19.6	22.4	42.0
Total		Count	36	41	77
		Expected Count	36.0	41.0	77.0

<i>Chi-Square Tests</i>			
	<i>Value</i>	<i>df</i>	<i>Asymptotic Significance (2-sided)</i>
<i>Pearson Chi-Square</i>	1.462 ^a	1	.227
<i>Likelihood Ratio</i>	1.466	1	.226
<i>N of Valid Cases</i>	77		

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 16.36.

b. Computed only for a 2x2 table

- Gender difference on preferred time for learning online (H4)

The results by gender from the respondents on their preferred time for learning online is shown in the bar charts as per figure 4.

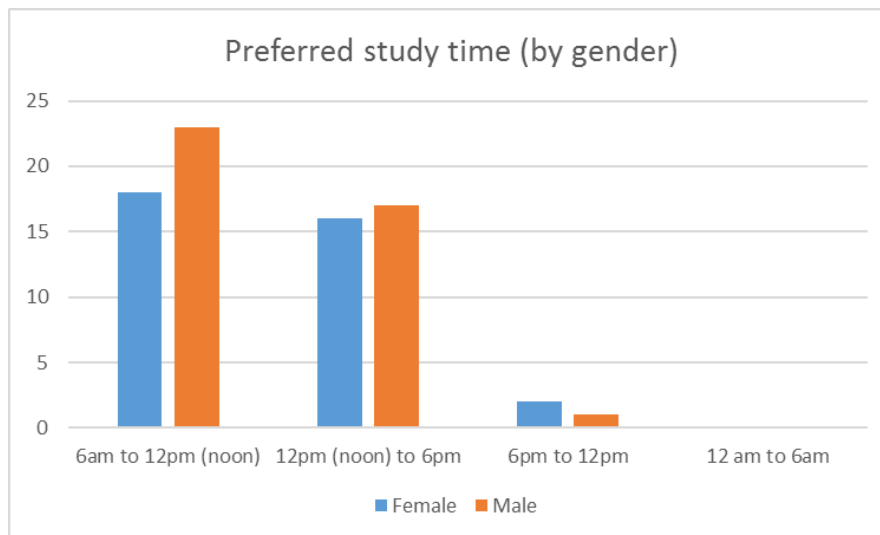


Fig. 4 - Count on preferred study time online by gender

Chi-Square test was conducted by using SPSS v.26 to examine statistical significance for gender difference exist or not. As per the table 5, the difference is not supported ($p < 0.05$).

Table 5 - Summary of Chi-square test on respondents' preferred study time online by gender

		Preferred learning time * Gender Crosstabulation			
		Gender			
		Female	Male	Total	
Preferred learning time	12pm (noon) to 6pm	Count	16	17	33
		Expected Count	15.4	17.6	33.0
	6am to 12pm (noon)	Count	18	23	41
		Expected Count	19.2	21.8	41.0
	6pm to 12pm	Count	2	1	3
		Expected Count	1.4	1.6	3.0
Total	Count	36	41	77	
	Expected Count	36.0	41.0	77.0	

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	.651 ^a	2	.722
Likelihood Ratio	.656	2	.720
N of Valid Cases	77		

a. 2 cells (33.3%) have expected count less than 5. The minimum expected count is 1.40.

- Conclusion of the significance tests on gender difference.

In overall, no obvious patterns be found between gender groups for both hypotheses 3 and 4. According to the results of significance test listed above, the differences are generally not supported, therefore, the null hypotheses 3 and 4 are not rejected. Accordingly, conclusion can't be made in terms of whether gender difference exists in terms of i) on the preference of when to attempt assessment and ii) on preferred time for learning online or not. However, although the conclusion can't be made, the results are reasonable when considering previous studies. This is because a mixed of findings were also found in previous studies (Barrett & Lally, 1999; Gunn et al., 2003) in terms of gender difference on learning.

5. Summary and Discussion of Findings

According to previous studies, we proposed 4 hypothesis and tests were conducted to evaluate these hypotheses. table 6 summarised the findings and results of the significance tests of this study.

Table 6 - Summary of hypotheses and findings

Hypothesis	Description	Findings	Significant test results
1	The preference of when to attempt assessment	More respondents prefer the questions to be asked during the video rather than after the video	Not support the hypothesis
2	The preferred time for learning online	More respondents prefer to study during morning or afternoon time rather than evening or midnight time	Support the hypothesis
3	Gender difference among learners in terms of their preferred time to attempt session's assessment when they attend session	No obvious patterns be found.	Not support the hypothesis
4	Gender difference among learners in terms of their preferred time for learning online	No obvious patterns be found.	Not support the hypothesis

In sum, these 4 hypotheses suggested that time and gender are two factors that would affect learners' preference in terms of when to attempt assessment and when to study. These suggestions were based on the assumption that learning is a process require inputs including attention span, cognitive load, working memory and there are gender difference on these inputs (Atkinson & Shiffrin, 1968; Leong & Sung, 2022). However, in our study, only the second hypothesis (H2) was supported by the results, that is learners has preferred time to study. For other hypotheses (H1, H3 and H4) that were not supported by the results.

We consider the reason behind this outcome was because the context of this study was conducted on microlearning settings where learning time is relatively short, usually less than 15 minutes, thus requires shorter attention span, less cognitive load and working memory from learners when compared with traditional classroom learning that usually last for at least 50 minute each session. Therefore, the required inputs including attention span, cognitive load, working memory become less important on influencing learners' preference. For example, in Hypothesis 1, as microlearning videos are in general short in length (usually to no more than 15 minute), therefore the amount of information embedded in each video would be relatively less and do not cause an overload of learners' cognitive capacity, therefore, answering questions during the video or after the video may not make a big difference from learners' point of view but if the video is lengthy, such as half-hour long video was used, the video is likely to contain richer information which exceed the memory capacity of learners, it's more likely that learners may want to answer assessment questions during the video rather than at the end of the video. Therefore, the preference of the learners would then change and become significant. Similarly, for a longer learning session, gender difference would be more obvious but these situations not applied to our study under microlearning context. The above reasons explained why significant difference had not been found for hypothesis 1, 3 and 4 among microlearning learners. On the other hand, for the second hypothesis, the preferred time of study which offer more and longer ranges of options. Our findings indicate that learners preferred learning during the day in morning or afternoon time rather than evening or midnight. A possible reason is learners would prefer to reserve evening time to do have study break and some balance between study and personal time which is also consistent with their study mode as full-time students. Building on these findings, we consider further studies such as qualitative studies could be conducted to generate deeper insights on learners' learning preference on microlearning.

6. Conclusion and Recommendations

This study aims to explore “when would online learners prefer to interact with multimedia microlearning in higher education context.” This study focuses on i) when do the learners prefer to attempt assessment and ii) what is the preferred time for learning online among learners. In addition, this study also evaluates whether gender difference exists on the above preference.

In order to obtain data to answer above questions, total population sampling was adopted in this study for data collection. Four hypotheses were developed and tested.

According to the findings and corresponding significance tests, implications are offered as below.

In practice, small activities can help to engage learners and enhance learning experience. For example, a quick check can draw learners' attention and ensure they are in the same page with the content. Given no obvious pattern was found from this study in terms of when the respondents prefer the questions to be asked, therefore, interactive activities can be freely arranged during the video or after the video according to instructional design and training need. For any assessment for a microlearning video, it can be arranged during the video and does not necessarily required to wait for the video to complete.

From the finding of this study, learning sessions, activities and messages should be scheduled and arranged during morning or afternoon time rather than evening or midnight time. More learners expressed that the morning or afternoon is their preferred online learning time. Therefore, interactions with learners and support provided during morning or afternoon time will be more effective.

Gender difference is a widely studied topic but this issue should not be overstated in the multimedia microlearning. From the results of this study, as gender differences is not obvious in all aspects, it is suggested that more efforts should be given on other implications, such as improving learners' sense of control rather than over-worrying any impact arose from gender difference.

Other than the above-mentioned implications for the multimedia microlearning, the findings raised by this current research also indicate several suggestions for future research.

Firstly, cross-disciplinary research could be conducted in order to provide new insights from different perspectives on how learners interact with multimedia microlearning interface design. For example, applications of electroencephalogram (EEG) and eye tracking. These technologies have widely been used in psychology studies in recent years. On this, conducting further researches together with experts from other disciplines can help to generate new knowledge on multimedia microlearning interface design.

Secondly, although no significant gender difference was found in this study, it is still worth studying the impacts of individual differences on multimedia microlearning from different aspects, such as learners' subject backgrounds, learners' results and learner's learning styles, etc. Related research can help to generate new understanding on how to provide effective and personalised learning experience to learners.

Lastly, it's worth mentioning that learning is a part of everyone's daily life. This research can be extended to other fields. In this fast-changing world, people are facing more and more new issues and challenges. How people respond to an issue depending on what they know but human knowledge is not born naturally, it is obtained through learning. The knowledge obtained from multimedia microlearning not only be applied in business training and learning, it can also be applied to many other areas, such as to study how to use multimedia microlearning to improve public health, to help protection of the environment and to improve digital literacy for people to cope with the 4th Industrial revolution.

Hopefully, this study could shed some lights on future research in the field of microlearning and higher education practice.

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