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A Study on Learners' Readiness for Flipped Learning

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A B S T R A C T

In information technology era, individuals are required to develop advanced technological skills to support professional development, and lifelong learning. Over the past decade, flipped learning, a learner-centered approach in higher education, has been increasingly implemented in many countries. This study aims to identify learners' readiness for the implementation of flipped learning and to examine the key factors influencing their readiness. A total 208 second-year students at the Mongolian National University of Education (MNUE) who are studying the "Introduction to Coding" course in 2024-2025 academic year were participated. The survey consisted of 20 questions with six criteria: general information, perception of flipped learning, learning styles, learning materials, technological readiness, learning attitude, and time management. The survey was analyzed using SPSS. The internal consistency of the questionnaire was confirmed with a Cronbach's alpha of $\alpha = 0.917$, indicating a high level of reliability. Correlation analysis revealed strong positive relationships among activities such as watching instructional videos on time, completing assignments in advance, and active participation in class ($r = 0.62–0.74$, $P < 0.01$). Factor analysis identified four main factors: learning environment, time management, participation, and engagement. The findings suggest that the research method can be used to detect student readiness for flipped learning.

1. INTRODUCTION

In recent years, learner-centered and active learning methodologies have been rapidly developing in the field of education, leading to a shift away from traditional lecture-dominated teaching style. One of the emerging approaches is flipped learning, which restructures classroom organization and transitions from a teacher-centered model to a learner-centered approach. This method is characterized by encouraging students to actively participate in learning and

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construct their own knowledge (Bergmann and Sams, 2012, p.50). Compared to traditional instruction, flipped learning allows students to study the course content in advance and consolidate their knowledge in the classroom, solve problems, and engage in collaborative activities that deepen learning (Zainuddin and Halili, 2016, p.315; Lo and Hew, 2017; p.2).

Some studies have shown that the effectiveness of flipped learning depends on many factors, including the appropriate planning of the methodology, as well as the readiness of the learner, the teacher, and the institution (Thai et al., 2017, p. 115; Abeysekera and Dawson, 2015, p.5).

A key distinguishing feature of e-learning, compared to traditional face-to-face learning, is that learners independently study course content by accessing information, participating in discussions, and engaging with audio and video materials regardless of time and place (Munkhtuya et al., 2024, p.81).

A key distinguishing feature of e-learning, compared to traditional face-to-face learning, is that learners independently study course content by accessing information, participating in discussions, and watching audio and video training materials regardless of time and place (Munkhtuya et al., 2024, p. 81). Consequently, teachers are encouraged to create new learning environments that foster independent study and to experiment with innovative teaching approaches. Some researchers have also highlighted that addressing challenges related to the quality and accessibility of distance learning facilitates the development of new forms of education models (Moore et al., 2011, p.130). This demonstrates the need to pay special attention to both learner and teacher readiness when integrating flipped learning methodologies into teaching.

Although flipped learning has been gradually introduced in Mongolia’s higher education institutions, research that comprehensively examines students’ participation, engagement, time management, and technological competence-particularly within teacher education contexts-remains limited. While these factors have been explored individually in previous studies, a few have investigated them together as indicators of student readiness for flipped learning. Therefore, the present questionnaire is expected to serve as a reliable research instrument and a practical tool for identifying student readiness when implementing flipped learning.

Flipped Learning and Readiness: In Mongolia, several policies and legal frameworks have been developed and implemented to enhance the quality and accessibility of higher education and to improve learning environments. National documents such as “Vision-2050”, the Law on Education, and the Law on Higher Education emphasize the importance of digitalization, open learning, and providing flexible learning opportunities in higher education (Vision-2050, 2024, p.4; General Education Law, 2023, p.5; Higher Education Law, 2023, p.2).

Consequently, it has become essential to effectively utilize various forms of e-learning to improve the quality and accessibility of education.

In the 21st century, citizens acquire the knowledge, skills, and competencies necessary to freely communicate, participate inclusively in social relations, and engage globally through e-learning and web-based learning, alongside traditional educational forms (Badamsuren and Munkhtuya, 2019, p.79). E-learning reduces the limitations of space and time, creating a flexible environment tailored to learners' needs and possibilities (Moore et al., 2011, p.82). Meanwhile, flipped learning combines the advantages of both classroom and online instruction, promoting active engagement and self-directed learning. The flipped learning methodology aligns with learning theories and principles of andragogy (adult learning), fostering increased learner participation, self-directed study, and technology-based flexible learning models (Bergmann and Sams, 2012, p.52). Western researchers consider constructivist ideas to be a theory of learning emphasizing that knowledge is best constructed through creative application and by combining it with other learning approaches and strategies (Ichinkhorloo, 2019, p.58).

Researchers have defined and interpreted the concept of flipped learning in various ways. As a relatively new term, its definitions, meaning, and forms have continued to evolve over time (Badamsuren et al., 2025, p.8). In essence, flipped learning redefines the traditional classroom model: teachers introduce lesson content before class, often in video format, and use classroom time for active, practical, and interactive learning (FLGI, 2024). Supported by artificial intelligence and digital technologies, flipped learning has become an effective instructional strategy that enhances students' autonomy, redefines the teacher's role, and improves overall learning outcomes. It has been noted that using AI tools in education helps learners set goals, engage in self-assessment, and develop learning strategies (Myagmargarmaa, 2025, p.148). Therefore, teachers in the new century need to keep up with a rapid social and technological developments and continuously develop their teaching methods.

Flipped learning is characterized by its emphasis on pre-class, in-class, and post-class engagement. Effective implementation of this approach requires careful consideration of readiness. Readiness refers to the capability of both learners and institutions to accept and implement new instructional methods. For learners, readiness encompasses self-regulation, motivation to learn, and technological competence. For teachers, it involves the ability to adapt to pedagogical innovations, design and utilize learning materials effectively, and integrate both online and face-to-face learning environments.

Table 1. Comparison of Models and Factors for Assessing Readiness

Model	Resource	Factors/Items/ Dimensions	Characteristics	Criteria								
				Learner Self-Regulation	Learning Motivation and	Teaching	Content	Technology	Communication	HumanResources	Culture	Infrastructure
Flipped Learning Readiness Scale	Hao. 2016	5/28/0	English	+	+			+	+			
Flipped Learning Readiness Scale (FLRS)	Kim et al. (2014)	0/50/4	Most frequently cited	+	+			+	+			
Blended Teaching Readiness survey	UNESCO (2022).	5/43/5	Blended learning – Teacher		+	+			+			
The Student Online Learning Readiness (SOLR)	Yu, Richardsan, 2015	4/20/3	Online learning					+	+			
Online Learning Readiness Scale (OLRS)	Hung et al., 2010	5/18–20/0	Online and blended learning	+	+			+	+			
E-learning Readiness Model	Aydin & Tasci (2005)	4/30/3	Organizational level		+			+		+	+	+
Technology Acceptance Model (TAM)	Davis (1989)	2/12/0	Attitudes toward technology acceptance (learners & teachers)		+			+				
Community of Inquiry (CoI) Framework	Garrison et al. (2000)	3/0/0	Learning quality, engagement, and core learning environment elements	+		+		+	+			

At the institutional level, factors such as human resource capacity, supportive policies, learning culture, and provision of technological infrastructure collectively determine the successful implementation of flipped learning. Hence, assessing readiness for flipped learning is not merely a preliminary step before introducing a new method - it is a critical indicator that influences the quality, sustainability, and learning outcomes of the educational process (Hung et al., 2010, p.1083; Gilboy et al., 2015, p.111). Researchers have examined learners' readiness for flipped learning from multiple perspectives, and the relevant models and measurement instruments are summarized in Table 1.

The models in table 1 aim to measure learning readiness from three different levels — teacher, learner, and institution. The Flipped Learning Readiness models developed by (Hao, 2016, p.299; Kim et al., 2014, p.41), and its focuses specifically on the flipped classroom environment, while the SOLR and OLRS models emphasize self-regulation, learning motivation, and technological competence within online learning environments (Yu and Richardson, 2015, p.6; Hung et al., 2010, p.1084).

UNESCO (2022) developed a tool to measure blended learning readiness, whereas Aydin and Tasci (2005) proposed a model encompassing institutional e-learning policies, infrastructure, and human resource capacity. The Technology Acceptance Model (TAM) evaluates the perceived ease of use and acceptance of technology, while the Community of Inquiry (CoI) Framework identifies indicators of cognitive, social, and teaching presence in learning environments (Davis, 1989, p. 321; Garrison et al., 2000, p. 89).

Researchers have noted that the effectiveness of flipped learning depends heavily on factors such as reliable internet connectivity, availability of smart devices, and access to learning platforms (O'Flaherty and Phillips, 2015, p. 86). Similarly, Hamdan et al. (2013) found that learners who possess prior online learning experience and strong self-directed learning skills tend to achieve higher success in flipped learning environments.

Because flipped learning requires learners to take responsibility for their own learning, motivation and intrinsic drive play crucial roles. Therefore, when designing the questionnaire to assess flipped learning readiness, the study incorporated elements such as learning motivation and attitude, understanding of flipped learning, learner self-regulation, self-directed learning and time management, learning styles, communication, and technological access, environment, and resources. Based on these criteria, a readiness assessment framework was developed, the survey was conducted, and the collected data were analyzed to determine key findings.

2. MATERIALS AND METHODS

Research Questions

This study was guided by the following research questions:

1. Which factors (e.g., self-directed learning ability, technology, learning environment) most strongly influence learners' readiness?
2. How does technological accessibility contribute to their readiness?

Research Design and Data collection

This study employed a quantitative research design using a cross-sectional survey method to assess learners' readiness for flipped learning.

The questionnaire used in this study was developed based on previous research on flipped learning readiness particularly drawing on the models proposed by Hao (2016) and Kim et al. (2014).

The instrument consisted of a total of 20 questions, including 5 demographic items (e.g., age, gender, major, year of study, and institution) and 15 items measured on a five-point Likert scale (1 = strongly disagree to 5 = strongly agree). Only the Likert-scale items were used for statistical analysis.

The questionnaire included six dimensions: general information, perception of flipped learning, learning styles, learning materials, technological readiness, learning attitude, and time management. Initially, the questionnaire was structured around five conceptual dimensions derived from previous studies on flipped learning and online learning readiness. These dimensions were identified based on international studies examining readiness for flipped and online learning. In addition, the questionnaire was developed by considering the specific characteristics of the university learning environment and teacher education context. Prior to the main study, the reliability and validity of the instrument were examined through statistical analysis.

Participants: The study involved a total of 208 students enrolled in the course "Introduction to Coding" at the Teacher's School, Mongolian National University of Education (MNUE). Participants were selected using convenience sampling. The sample consisted of 98.6% female, 1.4% male students, with an average age of 18.34 years (SD=0.83). All participants were majoring in Primary Education. Participation in the study was voluntary. Data were collected during the 2024–2025 academic year using an online questionnaire. All participants completed the survey voluntarily, and responses were recorded anonymously.

Data analysis

We used descriptive statistics, including mean and standard deviation, were used to determine the overall level of learner' readiness for flipped learning. In addition, reliability analysis was conducted using Cronbach's alpha to assess the internal consistency of the questionnaire. The reliability coefficient of the questionnaire was found to be $\alpha = 0.951$, indicating a high level of internal consistency. In addition, we used exploratory factor analysis (EFA) to identify the underlying factor structure of flipped learning readiness. Whereas, the suitability of the data for factor analysis was assessed using the Kaiser–Meyer–Olkin (KMO) measure and Bartlett's Test of Sphericity. Furthermore, we conducted correlation analysis to examine the relationships among key variables, particularly between technological accessibility, time management, and student participation. The data analysis allowed the identification of core dimensions influencing learners' readiness, including learning environment, time management, participant, and engagement. All data analyzes were performed in SPSS software package.

3. RESULTS

In this study, the correlation between students' flipped learning readiness and the influencing factors were analyzed using Pearson's correlation coefficient. As shown in Table 2, most of the questionnaire items exhibit a strong positive correlation with one another (r value ranged from 0.4 and 0.90). This indicates a high level of internal consistency among the items and suggests that they are appropriate for assessing a single underlying factor related to flipped learning readiness.

Our findings revealed that following questions "Which device do you use to watch video lectures?", "How actively do you engage in studying course materials independently?", "Do you have a reliable internet connection at home?", and "Are you ready to participate in flipped learning?" showed high positive inter-correlations (r value ranged from 0.80 and 0.88), indicating that these items could be grouped under a single factor, which primarily represents the technological dimension. Furthermore, the items "Are you ready to actively participate in both online and in-class activities?", "Are you able to manage your time to complete assignments before class?", "How much time can you allocate for independent study?", "Do you have a suitable learning environment at home?", and "Do you need additional support to successfully participate in the course?" were also found to be strongly correlated (r value ranged from 0.76 and 0.92), forming another factor that could be interpreted as the learner's study environment and self-regulated learning dimension (Table 2).

In contrast, the questions "Do you prefer learning through video materials?" and "Which format of course content do you find most effective?" showed low correlations with other items (r = 0.05–0.17), suggesting that they may constitute a separate factor. This distinction was further examined through factor analysis, which determines whether such items should form independent factor.

Table 2. Correlation Matrix of the Questionnaire Items

		A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15
Flipped Learning method-knowledge	Pearson Correlation	1	.675**	.177*	.517**	.125	.557**	.590**	.540**	.600**	.012	.475**	.436**	.461**	.452**	.460**
	Sig. (2-tailed)		.000	.011	.000	.072	.000	.000	.000	.000	.861	.000	.000	.000	.000	.000
Are you ready for self-directed learning?	Pearson Correlation		1	.142*	.616**	.152*	.736**	.763**	.664**	.708**	-.036	.546**	.486**	.490**	.522**	.547**
	Sig. (2-tailed)			.040	.000	.029	.000	.000	.000	.000	.608	.000	.000	.000	.000	.000
Format of course content	Pearson Correlation			1	.105	.269**	.106	.125	.151*	.099	.005	.112	.072	.047	.107	.149*
	Sig. (2-tailed)				.133	.000	.129	.073	.030	.155	.942	.106	.298	.496	.125	.032
When do you usually watch the videos?	Pearson Correlation				1	.139*	.849**	.703**	.739**	.745**	-.050	.485**	.445**	.466**	.494**	.486**
	Sig. (2-tailed)					.046	.000	.000	.000	.000	.477	.000	.000	.000	.000	.000
Choice of learning management system (LMS)	Pearson Correlation					1	.183**	.205**	.195**	.153*	-.036	.113	.147*	.129	.139*	.097
	Sig. (2-tailed)						.008	.003	.005	.028	.610	.104	.034	.062	.046	.163
Participation in flipped learning	Pearson Correlation						1	.860**	.833**	.886**	-.004	.507**	.457**	.475**	.512**	.525**
	Sig. (2-tailed)							.000	.000	.000	.959	.000	.000	.000	.000	.000
Device used to watch instructional videos	Pearson Correlation							1	.807**	.859**	.039	.521**	.461**	.475**	.526**	.561**
	Sig. (2-tailed)								.000	.000	.576	.000	.000	.000	.000	.000
Reliable internet connection	Pearson Correlation								1	.796**	-.027	.506**	.405**	.406**	.483**	.515**
	Sig. (2-tailed)									.000	.694	.000	.000	.000	.000	.000
	Pearson Correlation									1	.048	.531**	.458**	.450**	.540**	.562**

Studying course materials independently	Sig. (2-tailed)										.495	.000	.000	.000	.000	.000
Learning through video materials	Pearson Correlation										1	.052	.013	.001	-.012	-.008
	Sig. (2-tailed)											.453	.855	.993	.867	.908
Participation in online and in-class activities	Pearson Correlation											1	.830**	.775**	.868**	.863**
	Sig. (2-tailed)												.000	.000	.000	.000
Completing assignments before class	Pearson Correlation												1	.923**	.768**	.761**
	Sig. (2-tailed)													.000	.000	.000
Time spent studying per week	Pearson Correlation													1	.718**	.707**
	Sig. (2-tailed)														.000	.000
Suitable study environment at home	Pearson Correlation														1	.788**
	Sig. (2-tailed)															.000
Additional support	Pearson Correlation															1

**. Correlation is significant at the 0.01 level (2-tailed). *. Correlation is significant at the 0.05 level (2-tailed).

Eventually, our results indicate that the questionnaire items are suitable for comprehensively measuring flipped learning readiness, and that the 15 items effectively capture the key sub-factors of readiness. To assess data adequacy for factor analysis, the Kaiser–Meyer–Olkin (KMO) test and Bartlett's test of sphericity were conducted (KMO value = 0.906 $\chi^2 = 2851.524$, df = 105, P < 0.001). This indicated that the correlation matrix of the data differs from zero and that the items are interrelated.

Furthermore, we conducted factor analysis using the Rotated Component Matrix and the Varimax method. The questionnaire included five dimensions: perception of flipped learning, learning styles and instructional materials, learning and technological readiness, learning motivation and attitude, time management and support. As a result of the factor analysis, the initially proposed five dimensions were not fully revealed; instead, the factors such as, flipped learning and technological readiness and time management and environment were optimally identified based on the empirical data. In other words, comparing the criteria set during questionnaire design with the empirical results, four factors emerged, which explain flipped learning readiness more realistically. Namely, concept of flipped learning and technological accessibility, time management and learning environment, learning engagement, and learning material and format. The total variance explained by these four identified factors was 79.081%, which is statistically justified and an excellent indicator (Table 3).

Table 3. Total Variance Explained

Extraction Sums of Squared Loadings			**Rotation Sums of Squared Loadings**		
Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
7.781	51.876	51.876	5.269	35.128	35.128
1.859	12.393	64.269	4.269	28.463	63.591
1.207	8.048	72.317	1.307	8.711	72.301
1.015	6.764	79.081	1.017	6.779	79.081
Total	**79.081**			**79.081**	

Looking at the Rotation Sums of Squared Loadings in Table 4, the factors are evenly distributed, and the proportion of variance that was previously concentrated in the first factor (51.8%) has decreased, while the variance is more evenly spread across the other factors (35.1%). This confirms that an optimal structure consistent with the study data has been achieved. Furthermore, the 15 Likert-scale items were grouped into four factors based on their factor loadings obtained through exploratory factor analysis (Table 4). Factor loadings indicate the strength of association between each item and the underlying factor, with higher values representing stronger relationships. Loadings greater than 0.60 were considered significant.

Table 4. Rotated Factor Matrix Analysis Results

Rotated Factor Matrix[a]	F-1	F-2	F-3	F-4
What level of knowledge do you have about the Flipped Learning method?	.622	.327		
Are you ready to study the course materials independently before attending class?	.761	.341		
In which format do you find the course content most effective?			.812	
When do you usually watch the instructional videos?	.816			.312
Which system do you choose when studying the course content?			.763	
Are you ready to participate in flipped learning?	.919			
Which device will you use to watch video lectures?	.877			
Do you have a reliable internet connection at home?	.862			
How actively do you engage in independent study of the course materials?	.887			
Do you prefer learning through video materials?				.993
Are you ready to actively participate in both online and in-class activities?	.325	.885		
Are you ready to manage your time to complete assignments before class?		.911		
How many hours per week can you spend on independent study?		.868		
Do you have a suitable study environment at home?	.336	.832		
Do you need additional support to successfully participate in the course?	.366	.814		
Extraction Method: Principal Axis Factoring. Rotation Method: Varimax with Kaiser Normalization.				
a. Rotation converged in 5 iterations.				

The first factor represents concept of flipped learning, students' readiness for self-directed learning, and technological accessibility. For instance, items such as readiness to study independently, the time allocated to watching video lectures, and the technology use were high significance (0.622–0.919). The second factor is related to time management, environment, and learning engagement, including items such as willingness to actively participate in online and in-class activities, time management for completing pre-class assignments, weekly study hours, study environment, and additional resources (0.814–0.911). The third factor is associated with instructional materials and system choices, while the fourth factor consists of a single item representing the content and format of the course, indicating a predominant tendency among students to learn through videos. This is also related to students' learning styles and self-directed study learning strategies.

These results indicate that, unlike the initially proposed five factors, four factors were more accurately identified. Therefore, it can be concluded that readiness for flipped learning can be determined by four criteria: i) concept of flipped learning and technological accessibility, ii) time management and learning environment, iii) learning engagement, and iv) learning material and format. Although the interrelations and internal structure of the questionnaire were somewhat different from the researcher's initial hypothesis, it can be considered that a reliable and rational factor structure based on the reality of the data has been determined. This also shows that the effectiveness of flipped learning is directly related to students' time management, participation, engagement, and use of technology.

The original model with five factors was partially revised and redistributed into a more realistic structure. The results also show that students' self-directed learning skills, time management, and technological readiness are directly linked to learning outcomes (Table 4). This implies that teachers should consider both students' and the learning environment readiness to implement flipped learning effectively.

Moreover, the item "Are you ready to participate in flipped learning?" showed a high significance (.919), indicating that students have a high tendency to actively engage in and accept the flipped learning approach. Similarly, "Do you prefer learning through videos?" (0.993) clearly shows students' inclination to watch and learn via video materials. The item "Are you ready to manage your time to complete pre-class assignments?" (0.911) demonstrates that students have good time management skills and are prepared to complete pre-class tasks effectively.

4. DISCUSSION

The findings of this study directly address the research questions by identifying the level of students' readiness and the key factors influencing flipped learning implementation. To address the research questions, the results indicate that students demonstrate a generally high level of readiness for flipped learning, particularly in terms of technological accessibility, participation, and time management. Furthermore, the analysis identified four key factors influencing readiness: i) concept of flipped learning and technological accessibility, ii) time management and learning environment, iii) learning engagement, and iv) learning material and format. Among these, technological accessibility and self-directed learning behaviors were found to play a critical role in shaping students' readiness.

The results of this study indicate that students' readiness for flipped learning is significantly influenced by several factors including learning environment, technological accessibility, time management and student participation. These findings suggest that flipped learning readiness is a multidimensional construct that extends beyond individual learner characteristic and is shaped by both personal and contextual factors.

The identified four-factor structure is consistent with previous research emphasizing the importance of learner readiness in technology-enhanced learning environments. In particular, this finding aligns with Hung (2016, p.125), who emphasized that learner readiness is a fundamental factor, alongside teacher methodology and institutional support. Similarly, the importance of technological readiness and self-directed learning has been widely highlighted in flipped and online learning studies (Zainuddin and Halili, 2016, p.315; Lo and Hew, 2017, p.2).

Furthermore, this study is also consistent with Miyejav et al. (2022, p.2), who validated the Mongolian version of the Mon-SOLR instrument based on Yu and Richardson's SOLR model and confirmed its applicability in higher education settings. Their findings support the use of multidimensional constructs, including technological and communication skills, in assessing learners' readiness (Miyejav et al., 2022, p.2).

One notable contribution of this study is the empirical refinement of the initial five-factor model into a more concise four-factor structure. This suggests that learners' readiness for flipped learning may be more accurately understood when overlapping constructs such as technological readiness and conceptual understanding are integrated. In addition, the high reliability of the questionnaire (Cronbach's $\alpha = 0.917$) confirms that the instrument is appropriate for assessing students' readiness for flipped learning. This supports the use of the developed tool in similar educational contexts. From a practical perspective, the findings highlight that successful implementation of flipped learning requires not only well-designed instructional materials but also adequate technological access, effective time management skills, and active student engagement. Therefore, educators should consider both learner-related and environmental factors when adopting flipped learning approaches.

Overall, the study reinforces the idea introduced in earlier theoretical discussions that readiness for flipped learning is a complex and context-dependent concept influenced by multiple interacting factors.

Conclusion: Our findings revealed that students' readiness for flipped learning can be explained by four key factors: concept of flipped learning and technological accessibility, time management and learning environment, learning engagement, and learning material and format. These empirically derived factors provided a more accurate and realistic structure compared to the initially proposed five-factor model. The results indicate that students' readiness is strongly associated with their ability to manage time, engage actively in learning activities, and effectively use technological resources. This suggests that successful implementation of flipped learning depends not only on instructional design but also on students' preparedness and access to a supportive learning environment. In addition, the questionnaire demonstrated high reliability (Cronbach's $\alpha = 0.917$), confirming that the instrument is suitable for assessing learners' readiness for flipped learning. Therefore, the developed instrument and research approach can be used by educators and researchers to evaluate student readiness prior to implementing flipped learning.

Overall, the findings suggest that students are generally ready to adopt innovative and technology-supported learning approaches. However, effective implementation also requires consideration of broader factors such as institutional support, teaching strategies, and technological infrastructure.

Future studies should expand the sample size, include participants from different disciplines, and examine the readiness of instructors and institutions to provide a more comprehensive understanding of flipped learning implementation.

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CONFLICT OF INTEREST

The authors declare no conflicts of interest.

AUTHOR CONTRIBUTION

Munkhtuya Lkhagvasuren: Conceptualization; Methodology; Writing - original draft; Writing - review & editing. **Badamsuren Batsuuri:** Conceptualization; Methodology; Data curation; Writing - original draft; Writing - review & editing. **Jadamba Badarch:** Conceptualization; Methodology.

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