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Exploring Flipped Learning and Mental Health through the Metaverse: Interaction effects of Physical Education and Cyber Resilience

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ABSTRACT

This study has been conducted to explore flipped learning and mental health through the Metaverse. For this relation, the indirect effects of physical education and cyber resilience were observed. The concept of the metaverse is also getting introduced in many universities in China so that the satisfaction level of students can be improved based on trial ability, observability, compatibility, and complexity of different systems and platforms. Improving these factors can aid in enhancing the satisfaction of students regarding the use of these systems. The moderating role of physical education and cyber resilience cannot be ignored in this regard. This study takes into account the quantitative-survey-based approach. For this purpose, the data collection from post-graduate students of Chinese universities was done. A sample of 350 questionnaires was distributed among the students of postgraduate universities in China. Out of 350 questionnaires distributed among the target population but 318 questionnaires were attained and utilized in the current research to extract the data and find the results. After analysis, it was concluded that flipped learning through metaverse significantly impacts the mental health of postgraduate students of Chinese universities. The moderation of cyber resilience and physical education was also found to be significant between the flipped learning through metaverse and the mental health of postgraduate students of Chinese universities. This study has several practical implications for educators and learners as well. Our study draws valuable implications for the education department. For future studies, scholars should study flipped learning by combining it with some other teaching approaches. In the future, the studies can also focus on some other variables like students' motivation and achievement of the set learning outcomes.

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1. Introduction

In the last decade, continuous advancements in the education system of China have been observed. As a result of this, the concerns related to the mental health of Chinese students have gained the attention of many scholars, counselors, educators as well as psychologists (Hao, Shah, Nawazb, Barkat, & Souhail, 2020). Various digital technologies are being utilized by higher education institutes in China to modernize conventional teaching methods. A flipped classroom is one of the most commonly applied strategies in this regard (Li, 2018). Even though flipped learning through metaverse has encouraged

many Chinese students to communicate easily with one another as well as with the teaching facility. But the continuous use of technology has led to various health issues among Chinese students such as technology anxiety, depression, stress, and others. The promotion of advanced technologies in the Chinese education system has also led to easy accessibility to any required information by the students (Xu et al., 2019). This could result in a high alert for cyber resilience.

The covid-19 pandemic has prevented many students from returning to their schools and universities in China. As a result of this situation, the conventional mode of teaching became ineffective and was difficult to carry on (Sakti & Sukardi, 2021). The epidemic situation has resulted in many difficulties for teaching purposes. In order to resolve these issues, many educational sectors in China opted for digital means of providing education to students. The "Ministry of Education" in China has also encouraged universities as well as other educational institutes to utilize resources for promoting high-quality online education (Parkes & Barrs, 2021). This has also inspired many small private online courses (SPOC) at various Chinese colleges and also universities. This has helped in carrying out online tertiary education more effectively. The flipped classroom through the metaverse has been crucial in this regard. It has ensured the autonomous position of the students encouraging them to take charge of their own learning. This has improved the critical and also analytical thinking of the students. At present more than 100 universities in China are utilizing online flipped classrooms to promote adequate learning opportunities for the students. T. Tang et al. (2020) were also of the view that online flipped learning along with effective teaching methods are efficient in improving students' learning, attention as well as course evaluation. However, studies have also stated that flipped education helps in enhancing the cognitive abilities of the students and also promotes self-efficacy and motivation among the students. Another study conducted by Hinojo Lucena, López Belmonte, Fuentes Cabrera, Trujillo Torres, and Pozo Sánchez (2020) stated that in today's technological society, the inclusion of "information and communication technology" (ICT) has been favored in educational settings. This explains the increased internet usage in the modern world. Even though China is one of the largest countries in technology but it is still sensitive to cyber threats as nothing online is safe. Almost 62,000 cases of cybercrimes have been recorded by Chinese police in 2021 (Nuseir, Aljumah, El Refae, & Aburezeq, 2022). So increased implementation of flipped learning through metaverse has resulted in a large number of cybercrimes in China which has encouraged the training as well as courses associated with cyber resilience.

Flipped learning has emerged as an innovative approach in both the learning and teaching processes of physical education. (Østerlie, 2018) also discussed the significance of flipped learning in the context of physical education. The study stated that flipped learning motivates students to participate in physical education. The online learning data provided to the students encourage them to take control of their activities and it also promotes active learning. This has helped in improving the overall performance of the students by influencing their learning abilities effectively (Zhao, Liu, & Su, 2021). This leaves a positive impact on the mental health of students as they are provided a flexible learning environment by means of flipped learning through the metaverse. At present, the world has primarily become digitalized, which has encouraged the adoption of various digital technologies in different areas of work as well as life. Even the educational site is also not spared from the digitalization of the modern world, and various signs of progress are being promoted for transforming conventional teaching methods into updated digital non-conventional teaching methods (Galindo-Dominguez, 2021). Flipped learning through the metaverse has mainly been adopted by a large number of educational institutes due to the sensitivity of the situation as a result of the covid-19 pandemic. Where the world is dealing with anxiety and depression due to covid-19, flipped learning through metaverse has helped in providing a light of hope for students worldwide.

However, China was found to be impacted by covid-19 mainly as it was the epicenter of the outbreak of the virus. So the present study focused on the educational settings utilizing flipped learning through metaverse in the context of China. As a result of this, the students mostly spend their time in front of laptops or computers, that might not be a healthy sign for their mental as well as physical capabilities. Many health-related issues have been recorded in China due to the continuous use of digital technologies, which has raised many eyebrows. The government in China has taken essential measures for ensuring

online quality education for the students, but still, the relationship between flipped learning through metaverse and the mental health of the students is needed to be understood for detailed and practical knowledge. The main aim of the current study is to understand the relationships between the constructs of the study, which include flipped learning through metaverse, mental health, physical education, and cyber resilience. Thus, the proposed research questions for the present research study are presented as follows:

RQ1. What is the relationship between Flipped Learning through Metaverse and Mental Health of Post Graduate Students of Chinese Universities?

RQ2. What is the moderation impact of Cyber Resilience in the relationship between Flipped Learning through Metaverse and the Mental Health of Post Graduate Students of Chinese Universities?

RQ3. What is the moderation impact of Physical Education on the relationship between Flipped Learning through Metaverse and the Mental Health of Post Graduate Students of Chinese Universities?

For the current quantitative study, the data was collected from 350 postgraduate students of Chinese universities which offer flipped learning through metaverse in order to ensure the credibility of the collected data. Statistical tools were used to analyze the collected results. The observations of the current study clearly presented that flipped learning through metaverse has a significant and direct impact on the mental health of the students, while both physical education as well as cyber resilience also presented important moderating roles in this context, respectively.

The current study has been a practical addition to the literature. It is one of the initial studies to focus on the relationship between flipped learning through metaverse and mental health in the context of students of Chinese universities. Additionally, it has also focused on the role of physical education in this regard as it has been an essential mode of instruction for ages, and it could not be blurred under the impact of flipped learning. This has been effective in understanding the need for the transformation of the conventional education system to keep pace with the modern, digitally advancing world. Thus, the increased usage of digital technologies also makes the internet far from a safe place to be, so the understanding of cyber resilience in the context of flipped learning through metaverse is also focused on in the present study.

2. Literature Review and Hypotheses Development

2.1. Vygotsky Theory

Lev Vygotsky was of the view that social interactions were essential for promoting the cognitive growth of an individual (Strong, 2021). Cultural as well as social norms are also considered to impact the learning abilities of an individual. Teachers, parents as well as mentors are found to play a crucial role in this regard. This theory supported language as "the basis of learning." Lev Vygotsky claimed that both readings, as well as writing, are supported by the language. He was also of the view that reflective thinking, logic as well as reasoning were all supported by the language. This promoted the instructional strategies for emphasizing growth in literacy and also in the reassessment of the setup of a classroom. This theory promotes collaborative learning, leadership as well as critical discussions in classrooms. Independent tasks are encouraged as per this theory for obtaining meaningful as well as purposeful exchanges between the students and the teachers. The teacher is expected to facilitate learning and to ensure the contributions of students for improving their motivation as well as self-efficacy (Bradbury, 2021). The environmental learning settings are also considered to be essential in this regard as it impacts the interactions as well as communications between peers. The ideas of social connection presented by Vygotsky are implemented by various educational sectors to promote problem-solving skills as well as critical learning and cognitive skills. Vygotsky's theory highly appreciates active learning (Rohman & Fauziati, 2022). Thus, this theory has been found to be effective in determining the linkage between the constructs of the present study in order to develop an effective theoretical framework.

2.2. Flipped Learning through Metaverse (FLTM)

Schallert, Lavicza, and Vandervieren (2022) state that flipped learning is a student-centered method that transforms the traditional lecture style by using constructivism and collaborative learning (Schallert et al., 2022). Because students learn new things and review old ones outside of class, they have more time in class for group work, working together, and getting one-on-one attention from the teacher (Turan & Akdag-Cimen, 2020). Scholars have decided that the best way to describe flipped learning through metaverse is as interactive group learning activities in the classroom and direct computer-based individual education outside the school. Even though there is still disagreement about the idea and design of flipped learning and whether or not it includes videos that students watch outside of class. However, flipped learning through metaverse has become the talk of the town in recent years (Cheng, Ritzhaupt, & Antonenko, 2019). A growing body of literature and systematic reviews try to put all the evidence together, but there hasn't been much research done in virtual settings (Veres & Muntean, 2021). The present study has contributed to its role in improving the knowledge regarding FLTM effectively.

2.3. Mental Health (MH)

Mental health is referred to as "a state of mental well-being that enables people to cope with the stresses of life, realize their abilities, learn well and work well, and contribute to their community." This has attracted the attention of many researchers to determine the mental health of students in the context of the educational environment. Research by Tang, Hu, Yang, and Xu (2020) states that learning institutes are such a big part of young people's lives that they have the chance to improve their mental health and lessen the effects of some bad things in society. On the other hand, a school can be a significant source of stress, anxiety, and dissatisfaction for some kids, hurting their academic progress (Zeng, Chen, Wang, Zhang, & Deng, 2019). Because of this, it's essential to see the classroom as a natural place to teach young people about their rights to autonomy, security, and personal freedom while being aware of possible limits. Educational institutions are leading the movement to improve mental health. Conrad and Brendel (2020); (Hao et al., 2020) stated that the utilization of digital technologies results in pressure on the students to perform well. This might also impact their mental as well as physical performance. However, the present study has played an essential role in addressing this issue related to the mental health of the students.

2.4. Cyber Resilience (CR)

Estay, Sahay, Barfod, and Jensen (2020) demonstrate that cyber resilience is a system's ability to withstand and recover from shocks, focusing on long-term persistence (Dupont, 2019). For cyber resilience to be fully understood, it needs to be explained less abstractly. Metaphors and science need to be kept separate. The word resilience is expected to be used symbolically when discussing how systems react to changes. There are many different ways to study cyber resilience from a theoretical and methodological point of view. Still, there are only a few things that are common in these different approaches. Even if essential ideas and results continue to change and sometimes overlap, it can still be hard to see how they are connected (Zou, Choobchian, & Rozenberg, 2021). Also, technical language makes it harder for students to talk about cyber resilience with each other clearly (Mohebbi et al., 2020). This has gained the attention of the present research study, and thus the role of cyber resilience was also determined in the context of the mental health of the students in a flipped learning setting.

2.5. Physical Education (PE)

Physical education has traditionally been seen as more "hands-on" and "practical" in an educational setting as it encourages the students to perform physical activities together, which connects them socially. As a direct response to the current Covid-19 outbreak, Spain has moved all its physical education classes through the metaverse. This practice has largely impacted the decisions of job seekers in the field of physical education (Pluim & Gard, 2018). On the other hand, China has been slow to use digital tools to teach physical education, preferring a more traditional and hands-on approach (González-Calvo, Varea, &

García-Monge, 2022). Research has shown that physical touch is much more important in Chinese culture than in Anglo-Saxon, Scandinavian, or Asian cultures (González-Calvo et al., 2022). This limitation has encouraged the present study to focus on the role of physical education in the context of flipped learning to understand the relationship between them.

2.6. Flipped Learning through Metaverse (FLTM) and Mental Health (MH)

Flipped learning through metaverse helps in promoting an active learning environment which is one of the basic factors supported by Vygotsky's Theory in order to develop cognitive skills among the learners. Various researchers strengthened the association between flipped learning and Vygotsky's Theory. Another study conducted by Zheng, Bhagat, Zhen, and Zhang (2020) showed that the students learning in flipped classrooms were more motivated and active as compared to the ones studying in traditional classroom settings. Flipped learning through metaverse has helped in promoting student-centered learning, which improved the critical thinking of the students improving their overall mental performance. However, Qin, Zheng, and Wang (2019) stated that excessive use of technology might lead to boredom or fatigue in an individual, degrading mental health. The excess of anything is considered to be a toxin. Similarly, the excess internet usage might also deviate the students from their actual course and indulge them in other activities. This shows the social impact of surroundings on the performance of an individual. However, another study stated that flipped learning supports constructivism and results in successful learning activities for the students. Flipped classroom provides an opportunity for the students to interact with one another more effectively. However, flipped learning through the metaverse has helped in lowering the distances more effectively. Lo (2020) says that the flipped learning model helps students develop skills that can be used in the educational atmosphere. Skills boosting mental health include thinking critically, studying independently, communicating well, solving problems, and getting along well with others.

Sailer and Sailer (2021) were of the view that in the context of flipped learning, students use class debates, games, role-playing, and think-pair-share activities to solve problems more in-depth (Sailer & Sailer, 2021). This promotes critical thinking as well as active learning. Flipped learning is effective in developing higher-order cognitive skills like the ability to apply, analyze, and evaluate the available information. Thus, from the above discussion of the past conducted studies, the following hypothesis is developed for the present study:

H1. Flipped learning through the metaverse significantly impacts mental health.

2.7. Flipped Learning through Metaverse (FLTM), Cyber Resilience (CR), and Mental Health (MH)

Ahmed, Buragga, and Ramani (2011) focused on the current design paradigm for flipped learning, the problems found in the many flipped learning methods, and how they can be related to cyber resilience. Flipped learning integrates both conventional learning methods as well as non-conventional e-learning methods. This introduces the cyber-based learning technology that defends against cyber-attacks (Verhulsdonck, Weible, Helser, & Hajduk, 2021). Various challenges are faced by e-learning methods, such as it is hard to add new features and it is expensive to adopt new e-learning systems. Moreover, the idea of system security for protection from cyber-attacks is a new approach in the context of the education system through flipped learning, hoping that its discussion will make online learning platforms more scalable, flexible, and easy to use. The author looked into both the pros and cons of using a traditional networking architecture for flipped learning and the possibility of moving the e-learning system to a resilient cyber infrastructure in places that aren't usually associated with schools or businesses (Hwang & Chang, 2020). The fees charged from the school are also based on this, which could hurt students from low-income families and their mental health (Mouheb, Abbas, & Merabti, 2019).

According to Vygotsky's Theory, the educational setting is also crucial for developing cognitive skills among the students and promoting their autonomy of students (Erbil, 2020). However, in a flipped education setting, the security of personal information of students and related data has become quite a concern for both the management as well as the students

themselves. This has encouraged various programs as well as training in the context of cyber resilience to ensure the effective usage of digital platforms for carrying out e-learning processes (Cevikbas & Kaiser, 2020). Considering the significance of cyber resilience in this regard, the present research study has also focused on determining the influence of cyber resilience in the context of flipping through a metaverse. The following hypothesis is formulated as a result of the above debate from the previously conducted studies:
H2. Cyber resilience significantly moderates the relationship between flipped learning through metaverse and mental health.

2.8. Flipped Learning through Metaverse (FLTM), Physical Education (PE), and Mental Health (MH)

Research shows that teens taking physical education classes often experience negative attitudes and peer pressure, i.e., considered to be good for mental health (O'Brien et al., 2020). Scholars are of the view that male students and those who take hybrid classes and play sports outside the school experience more mental benefits in contrast to the students who sit ideally. Hinojo-Lucena, Mingorance-Estrada, Trujillo-Torres, Aznar-Díaz, and Cáceres Reche (2018) stated that the merging of flipped education as well as physical education, improves the overall achievement of the students. It helps in providing them with unique transformational experiences. As a result of such practices, the students are more likely to have higher levels of self-efficacy which positively impacts their performance. Many other past conducted studies were also of the view that physical education is more beneficial in bringing together students as they get to collaborate with one another physically whereas, in an online teaching setting, the students are not able to communicate with one another physically and are bounded by technology for effective communication (Botella, García Martínez, Molina García, Olaya Cuartero, & Ferriz Valero, 2021). Even though many studies have also advocated the significance as well as the implementation of flipped education in order to keep updated with the modern world, still a lot of work is needed to be done in this regard as many external as well as internal factors are found to be influencing the learning capabilities of the students in this context (Cruickshank, Pill, & Mainsbridge, 2021). As per Vygotsky's Theory, language is the most important factor for developing cognitive skills; thus, physical education could also be effective in understanding the body language of an individual who is far more observant in the case of online learning. Such discussion has helped in developing the following hypothesis for the current study effectively:

H3. Physical education significantly moderates the relationship between flipped learning through metaverse and mental health.

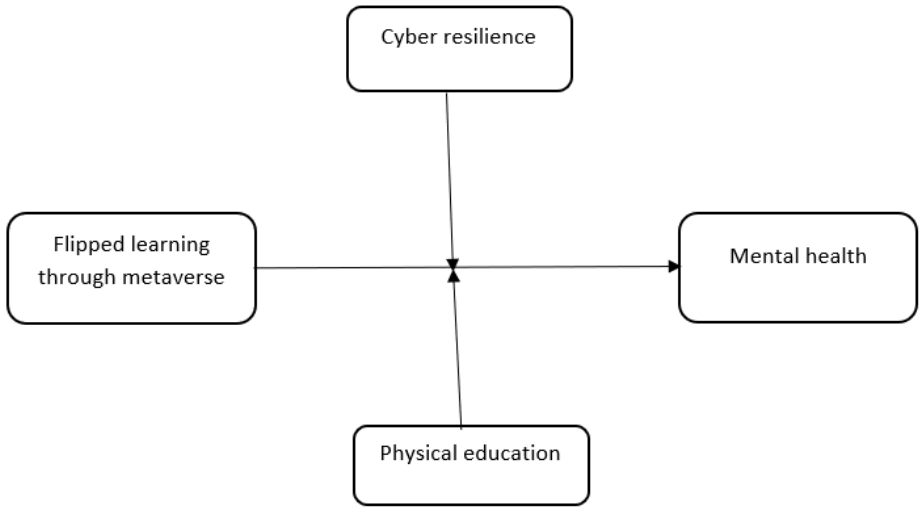

Figure 1: **Proposed Theoretical Framework of the Study**

3. Methodology

The research was conducted methodologically by taking into account the descriptive and relational details. The data were thus collected from the postgraduate students of Chinese universities. The data were thus collected by utilizing the survey-based approach

and a survey questionnaire. In addition to collecting data, the students were informed in detail regarding the study. The questionnaire was comprised of two sections. The demographic features of the participants in this research were gained in the initial section of the questionnaire. The second part was based on the questions regarding variables included in our study. The respondents were asked to fill out the questionnaires on a five-point Likert scale. The non-probability convenience sampling approach was adopted to obtain the data. The data was collected from 350 respondents. SPSS was utilized for the central analysis, whereas AMOS v.24 was adopted for structural equation modeling (SEM) to test the hypothesis.

3.1. Questionnaire Design

The questionnaire in this research was intended on a Likert scale. When the data has to be collected from a large population, then the questionnaire-based survey method is considered suitable. Although the method of data collection is important to gain the data from respondents, so it is quite convenient for the researcher to collect the questionnaires for data analysis. After comprehensive detailed research on the related variables, we also formulated and utilized the technique of questionnaires for the data analysis. The selected scales were decided after a detailed procedure of reviewing several related pieces of research. The scale used to study cyber resilience in the research is adopted by Linkov and Kott (2019). Measurement of mental health as the variable in the current research has been studied using the scale defined by Irfan (2016). The scale used for measuring physical education is adopted from the research of Shannonhouse (2012). The scale has used six different physical education items, contributing to examining the results obtained from the research. Flipped education through meta-verse is studied under the scale provided by ORTEGA-RODRÍGUEZ (2022). The author has used four different items in a combined form to study the variable of flipped education through meta-verse.

Table 1
Measurement Items

Variables	No. of items	Reference
Cyber Resilience	Nine	(Linkov & Kott, 2019)
Mental Health	Six	(Irfan, 2016)
Physical Education	Six	(Shannonhouse, 2012)
Flipped Education through Meta-verse	Four	(ORTEGA-RODRÍGUEZ, 2022)

Understanding the concept of flipped learning through the metaverse plays an important role in mental health with the moderation impacts of cyber resilience and physical education being critical. The scales used in this study, however, were used in previous studies to understand flipped learning and mental health through the metaverse. Furthermore, the opinions of the experts were taken into account and accessed when investigating the face validity of these items used as a scale in questionnaires. As a result of gaining positive opinions and constructive responses from those experts, the well-formulated scales from the most referenced article were combined into the questionnaire to gain the data from our target population adequately.

3.2. Data Collection Process

Principally, we carefully choose the different Chinese universities as we were targeting the postgraduate students of Chinese universities. The purpose of this research was explained to the management of the university. Our targeted population as stated before was the postgraduate students of Chinese universities. The technique of non-probability convenience sampling was adopted and students with the designed questionnaires after ensuring the brief provision of details necessary to complete the questionnaires. Most importantly, the consent of respondents was obtained fully to respond to the questionnaires. Additionally, a positive response from the students regarding their opinions on the designed questionnaire was gained. The Students were also permitted to get any precision about any misunderstanding while finishing the survey questionnaire. We distributed 350 questionnaires to the Chinese Universities and 32 questionnaires were not used because they were incomplete majorly; 318 were fit to be examined for this research.

Therefore, our response rate was 87%. Finally, the efforts of students were recognized for their undertake participation, and they were thanked for their precious time and involvement in the research.

4. Findings

4.1. Respondents' Demographic

As this research has targeted the postgraduate students of Chinese universities. Questionnaires were distributed to 350 respondents who were currently studying at a Chinese university. The demographic characteristics of the respondents were assessed. The received questionnaires that were complete and authentic were 318. The demographic features of the respondents were reported such as in the received complete questionnaires, there were 160 female students and 158 male students with a percentage of 52% and 48% respectively. This figure reported that nowadays female students are more inclined towards getting an education as their enrollment was a bit more as compared to the male students. The age of students also varied as the respondents having age of 20-22 years were 40 and the students within the age group of 23-25 were 176, and the senior students falling in the age group of 25-27 years were 102. This was also a positive sign as our research demanded accurate opinions from the postgraduate students and the response rate was more for the students in the age category between 23-25. They were more informed about the effect of flipped learning through the metaverse and its impact on mental health along with the dual moderation of physical education and cyber resilience. The percentage rate of these responses has also fluctuated as the 40 students between the age of 20-22 had a cumulative frequency of 17%, the cumulative frequency of 176 students between 23-25 had a cumulative percentage of 46% whereas the postgraduate students fell within the age group of 25-27 had a frequency percentage of 37% respectively.

4.2. Validity, Reliability, and Measurement Model Tests

The extent to which constructs vary from each other is the discriminant validity and the convergent validity is the level of relatedness of one scale to the other variables or other measures concerning similar constructs. It is of huge significance in the field of research to measure the validity and assess the results as it guarantees the authenticity and accuracy of the data. The convergent validity is analyzed by making comparisons of the results of an investigation with that of other constructs that are measuring a similar construct.

Table 2
Discriminant and Convergent Validity

	CR	AVE	MSV	CR	MH	PE	FLM
CR	0.927	0.692	0.319	**0.877**			
MH	0.901	0.782	0.352	0.856	**0.817**		
PE	0.999	0.810	0.399	0.601	0.577	**0.955**	
FILM	0.812	0.616	0.345	0.510	0.571	0.411	**0.808**

Table 2 presents the results of discriminant and convergent validity as it demonstrates that all the variables are distant from the other variables. Such as the cyber resilience discriminant validity is 0.877 distinct from the constructs such as mental health, physical education, and flipped learning through a metaverse. Similarly, all the other variables have also a distinct value of discriminant validity that is different from the other values such as indicating distinction. It thus emphasizes that the measures that emerge from another measure consisting of a primary construct are unrelated to it conceptually. The other interpretation of convergent validity is measured through composite reliability and average variance extract. The internal consistency of flipped learning through metaverse, cyber resilience, physical education, and mental health of postgraduate students in Chinese universities has been confirmed through composite reliability. The acceptable values of CR should not be less than 0.7 and our results also indicate that the variable is acceptable. The standard values define concerning the stated measures fit perfectly indicated in the results obtained. The last criterion is to examine the average variance extracted (AVE), and the threshold figure of AVE is 0.5. No items were released, and there were no problems with AVE in the data set. The values of CR, MH, PE, and FLM have values that fall in the exact range of the standard said threshold range. The output

values of the complete convergent validity test, as shown in Table 1, highlight that the measurement model of our data set fulfills all the requirements for convergent validity. Therefore, convergent validity was decisively formulated for this study, and we moved toward the next step of tests.

4.3. Model Fitness

The contemporary results take into account the confirmatory factor analysis as a statistical tool that is used to guarantee or check the factor structure regarding the set of variables observed. In this study, we have four variables central for running model fitness The CFA test allows and enables the researcher to investigate the hypothesis that a connection among variables observed and their latent variable presence.

Table 3
Confirmatory Factor Analysis

CFA Indicators	CMIN/DF	GFI	IFI	CFI	RMSEA
Threshold Value	≤ 3	≥ 0.80	≥ 0.90	≥ 0.90	≤ 0.08
Observed Value	1.489	0.892	0.938	0.918	0.037

The standard values of IFI, CFI, and RMSEA are explained in the table for IFI the fit value is ≥ 0.90, for CFI the value is ≥ 0.90 and for GFI and RMSEA the values are 0.892 and 0.037. These values indicate that the model formulated or the concerned hypothesized model is fit and accurate.

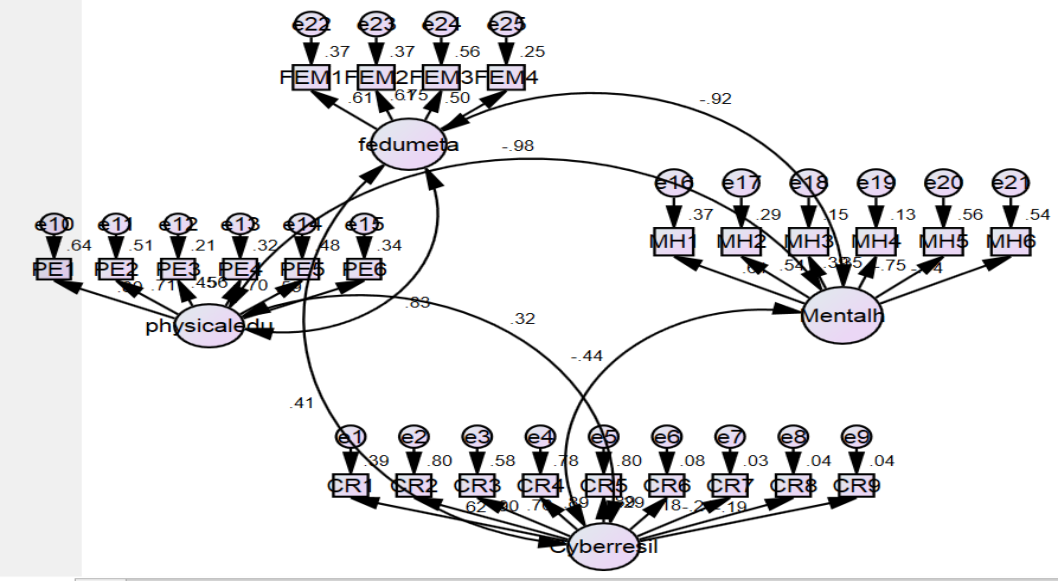

Figure 2: Measurement Model

The figure 2 of confirmatory factor analysis is an integral form of factor analysis. Figure 1 describes that the measures of the construct are reliable and fit the hypothesized mode. The hypothesis of the research is developed initially regarding the crucial constructs involved in the study, along with the used measures, and may contain limitations and restrictions concerning the model depending on the formulated hypothesis. By taking these restraints into account, the research emphasizes aligning the research model with the theory. The process of confirmatory factor analysis is an authentic and reliable procedure. So, the variables are compulsory to weigh only on exact and the concerned positive factors, so that accuracy and fitness measurement of the formulated model can be gained and measured. So the confirmatory analysis makes the investigator capable to examine the formed hypothesis in a specific way so that a proper connection between variables of the study and their latent applicable variable that possibly happens

4.4. Descriptive Results

The table 4 of descriptive statistics mainly determines the normality and guarantees the non-existence of an outlier in the data. So, the above table explains that the mean values are 3 or near 3 ensuring the normality of data along with the accurate expected figures for standard deviation and skewness. The cut-off figures accepted for the skewness falls within the range of -1 to +1. The descriptive results thus inform about the skewness values for CR, MH, PE, and FLM to be in the fit range of -1 and +1. The results thus guarantee the normality existence in the data and it is correspondingly disseminated as all figures obtained through this test lie among the stated and accepted range of the cut-off value of skewness. The table also explains that there is no outlier in the data that interposes it.

Table 4
Studied Descriptive Variables

	N Statistic	Minimum Statistic	Maximum Statistic	Mean Statistic	Std. Deviation Statistic	Skewness Statistic	Std. Error
CR	318	1.44	4.89	3.1544	.71868	-.097	.241
MH	318	1.67	4.33	3.0867	.60138	-.175	.241
PE	318	1.17	5.00	2.8550	.98321	.165	.241
FLM	318	1.00	5.00	2.7750	.90095	.180	.241
Valid N (listwise)							

4.5. Rotated Component Matrix

Table 5
Alternated Component

	Component			
	1	2	3	4
CR1		.752		
CR2		.891		
CR3		.768		
CR4		.879		
CR5		.863		
CR6		.823		
CR7		.841		
CR8		.872		
CR9		.834		
MH1			.757	
MH2			.727	
MH3			.506	
MH4			.457	
MH5			.648	
MH6				
PE1	.754			
PE2	.628			
PE3	.649			
PE4	.620			
PE5	.726			
PE6	.555			
FLM1				.701
FLM2				.782
FLM3				.773
FLM4				.791
FLM5				.782

The rotated component matrix informs the researcher regarding the cross-loading of questionnaire items. The above table explained that there is no cross-loading of the items of the variables because all the columns have items related to the respective variable which means that the items were fairly presented and loaded in the questionnaire guaranteeing the authenticity of values. The values of the rotated component matrix fall between 0.40 to 0.80 and the constructs of this study such as CR, MH, PE, and FLM indicate that there is no issue of double loading or cross-loading in the variables. Examining the factor loading is one of the important indicators for ensuring the Convergent reliability of the results.

4.6. Structural Equation Modelling (SEM)

To assess the final status of the hypothesis in research, the regression analysis is mainly performed. This analysis is referred to as structural equation modeling. Structural equation modeling is a set of techniques of statistical nature that are utilized to assess and evaluate the connections of the observed and dormant variables. Same but strengthen than the typical regression analysis, it investigates the direct linkages among variables along with the indirect exerting impacts of moderators or mediators.

Table 5
Structural Equation Modeling

Effects	Hypothesized Path	B	S.E	P value	Conclusion
Direct Effects					
Hypothesis 1 (+)	FLM → MH	.143	.052	0.02	Accepted
Moderation Effects					
Hypothesis 2 (+)	FLM*CR→ MH	.168	.051	0.01	Accepted
Hypothesis 3 (+)	FLM*PE→MH	.181	.075	.002	Accepted

There are a total of three hypotheses in this study. The first direct or linear impact that needs to be assessed is the impact of flipped learning through metaverse on mental health. The status of a hypothesis i.e. whether it is accepted or not is judged after reporting the p-value of that particular hypothesis. The p-value of this hypothesis is indicating its significance. If the probability value is less than 0.05, then the hypothesis is accepted and vice versa. So, regarding the first impact, it can be concluded that the concerned direct impact is significant (FLM → MH, β= 0.143 and p < 0.02). The moderation of the two variables has also been analyzed separately. In figure 1 below, it can be observed that cyber resilience significantly moderates the relationship between flipped learning through metaverse (FLM*CR → MH, β= 0.168 and p < 0.01) and the mental health of postgraduate students of Chinese universities (FLM*PE → MH, β= 0.181 and p < 0.002). The p-value, again, is less than 0.05 indicating the significance of this hypothesis.

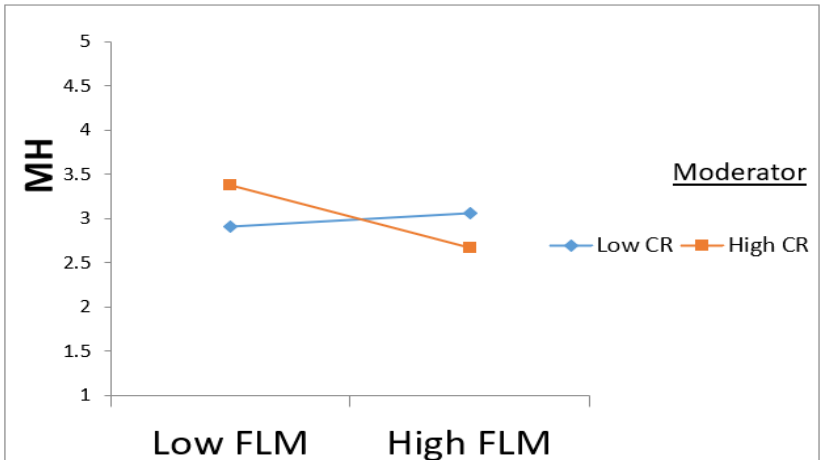

Figure 3 Cyber Resilience moderation

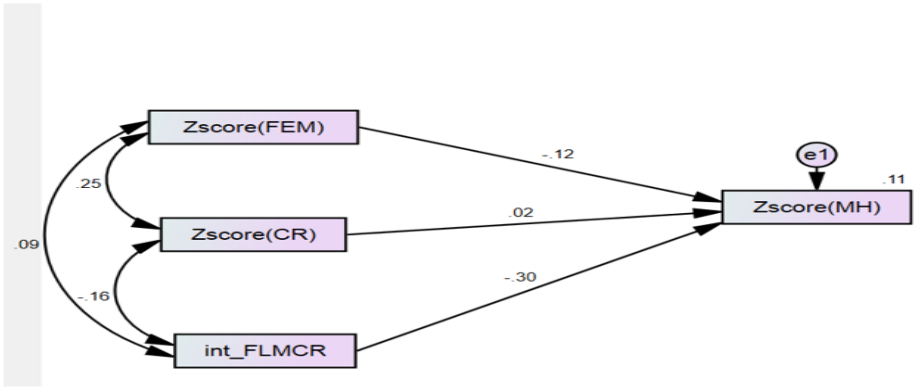

Figure 4 SEM Results of CR Moderation

The third and last hypothesis has a p-value of 0.00 indicating that physical education strongly and significantly moderates the relationship between flipped learning through metaverse and the mental health of post-graduate students of Chinese universities which is the targeted sector of our research. The below graph in figure 5 of physical education moderation explains that two lines instead of traveling parallel to each other, perfectly intersect each other indicating the significance of the moderation's impact between the dependent and the independent variable.

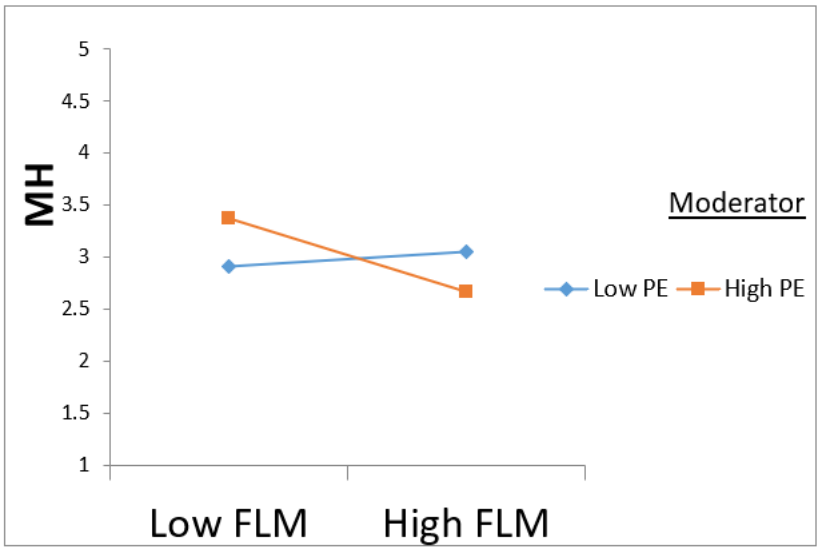

Figure 5 Physical education moderation

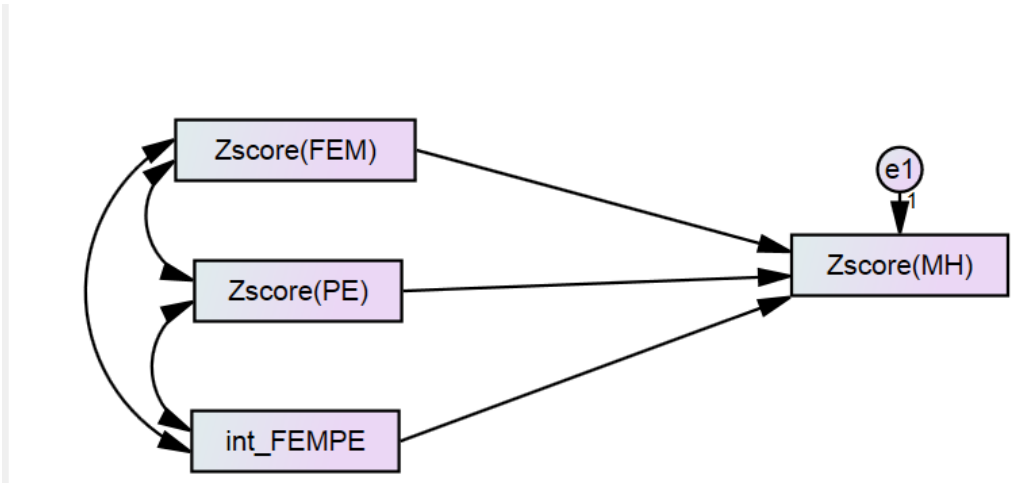

Figure 6 SEM Results of PE Moderation

5. Discussion

The flipped classroom model can be implemented in Chinese classrooms, thanks to modern technology. Successful instances and results demonstrate how this paradigm fosters Chinese students' independent learning and cooperative learning while also enhancing parents' feeling of obligation for parental support in schooling (Yang, 2014). Past studies have examined the flipped classroom model and overall learning of students which also improves their mental health. (Rodríguez, Díez, Pérez, Baños, & Carrió, 2019) conducted a study to examine the flipped classroom model's implementation in health science students of undergraduate level. They examined how flipped classrooms helped to foster critical thinking and mental development in students. The findings revealed that (i) students believed they had improved their critical and creative thinking abilities as well as their social consciousness during the flipped classroom approach; (ii) students were very comfortable with this teaching strategy and suggested that it be implemented as a normal practice of the syllabus; (iii) using this method produced improved learning results than formal instruction; and (iv) the duration of meetings and the type of understanding to be covered were a factor in how well students learned. One of the best advantages of flipped learning is improvement in students' learning which is related to their improved mental health (Akçayır & Akçayır, 2018). By implementing a blended learning approach to instruction at various levels of undergraduate and graduate study, educational processes can be improved. The past study conducted in Saudi Arabia on flipped classrooms also concluded that flipped classrooms, a comparatively recent idea in Saudi Arabia, exhibit beneficial results with higher levels of student satisfaction. In flipped classrooms, active pupil learning takes the place of passive lecture to improve analytical reasoning, applicability, and retention of knowledge. This study was conducted on undergraduate medical students (Sajid et al., 2016). In another study conducted by (Street, Gilliland, McNeil, & Royal, 2015), the role of flipped classrooms in improving students learning and mental satisfaction has been observed. The results showed that there has been a gain in mental satisfaction and learning (mental health) by employing flipped classrooms model. The impact implication of flipped classrooms and gamification in developing independent learning and motivation has been observed among primary school students in Spain and the results showed enhanced motivation and autonomy which leads to improved mental health (Gómez-García, Marín-Marín, Romero-Rodríguez, Ramos Navas-Parejo, & Rodríguez Jiménez, 2020). In another study, the impact of flipped classroom education on students' self-regulation and social connectivity during the preparation year was investigated. According to the results, kids who experienced flipped classrooms significantly outperformed their peers in the traditional group in terms of self-regulated learning and social connectivity. The outcomes show that the flipped classroom approach can be utilized to encourage independent learning and strengthen students' social connections (Jdaitawi, 2019).

Our study also tried to examine the impact of flipped classrooms on the mental health of students but in this study, the moderating role of physical education and cyber resilience has been also discussed. The moderating role of physical education and cyber resilience on the relationship between flipped learning and mental health has not been extensively studied in the past. Our study also focused on students of the postgraduate level while past studies mostly focus on the primary and undergraduate levels. Although physical education has been studied in past for improving mental health and less pressure on students. According to (Stellie and Mehus 2020), physical education can help prevent or minimize the symptoms of more than thirty mental health issues. According to research (O'Brien et al., 2020) youths who enroll in physical education classes must deal with societal pressure and unfavorable attitudes. Similarly, cyber resilience-related studies have also been conducted. The concept of system security for defense against cyber-attacks is a fresh take on learning through flipped learning, with the hope that its debate would make online learning systems more accessible, adaptable, and user-friendly. The author investigated the benefits and drawbacks of flipped learning utilizing standard networking design as well as the potential for transferring the e-learning system to a resilient cyber infrastructure in locations that aren't often connected with schools or companies (Hwang & Chang, 2020). Our research model presents the moderation role of these two variables on the relation between flipped learning and mental health in the metaverse so we are presenting a novel research model in the field of flipped learning and mental health among students.

In this study, we proposed three hypotheses. Our first hypothesis was about the direct relationship between flipped learning and mental health it states that flipped learning is positively linked to mental health. Our second hypothesis states that cyber resilience significantly moderates the relationship between flipped learning through Metaverse and mental health. Our third hypothesis states that physical Education significantly moderates the relationship between flipped learning through Metaverse and mental health. Our study's findings accept all three hypotheses as through analysis we found that the P value is less than 0.05 which accepts all three models.

6. Conclusion

In summary, our study focused on examining the role of flipped learning on the mental health of students. The two main aspects of the study were cyber resilience and physical training. The moderating role of these two variables on the relationship between flipped learning and students' mental health has been accessed. In this digital era, flapped learning is a teaching methodology that uses mixed method approaches online and face-to-face lectures which include students' active engagement. They try to solve real-world problems. The learning capability can be enriched at various phases of education by using the flip learning instructional methodology.

The study shows that there is a significant relation between flipped learning and mental health as the students who experience flipped learning in any module or course, develop strong mental health. They are more able to think critically and logically. They can give a better academic performance. Physical education and cyber resilience also have a significant moderating impact on the relation between flipped learning and the mental health of the students. Online lectures help students in overcoming the barrier of time and location. Flipped learning is gaining importance in Chinese academic institutes day by day. So, studies related to flip learning can prove beneficial for teachers and students as well.

6.1. Implications

6.1.1. Theoretical Implications

The current work is theoretically beneficial as it adds to the existing literature on the flipped learning and its influence on the mental health. Which will in turn maximize the benefits of implementing flipped learning for students learning and motivation. Moreover, this study has been based on the self – determination theory which makes a strong connection between an individual personality, his peak performance, and internal motivation. It links flipped learning with enhanced positive outcomes that lead to improved mental health. This study makes an addition to existing theory by discussing the moderating role of physical education like outdoor activities and environment and cyber resilience. It adds literature to existing literature regarding flipped learning and mental health. Likewise, further research and studies can be conducted on the findings of this research. Some of the benefits of adopting flipped learning on the mental health of the students suggested by the literature review include increased creativity, innovative thinking, improved satisfaction and positive social influence.

Flipped learning through metaverse has helped in transforming the conventional form of teaching. This could be effective in encouraging various institutes to opt for flipped classroom as it is effective in promoting active learning which could be beneficial for promoting the cognitive skills of the learners. Additionally, to further understand how various learning strategies like flipped learning through metaverse can improve students' capacity improve their own learning, more research is also required.

6.1.2. Practical Implications

This study has several practical implications for educators and learners as well. Our study draws valuable implications for the education department. As the study shows the significant role of flipped learning in improving the mental health of students so this mode of teaching can be utilized by schools and all other academic institutes for enhancing mental health among their students. Students can also trust this kind of teaching method. It can assist students in improving their academic performance as mental health and satisfaction lead to an overall improvement in performance. The study's findings are also helpful for the cyber security department which works for the protection of online platforms in the educational field. As the study shows the moderating impact of cyber resilience on the

direct relationship between flipped learning and the mental health of students. Physical trainers must also get help from this study's results as physical training and education is also playing a moderating role. Curriculum developers should take advantage of this study's results so that they can design their curriculum in such a way that can be applied to real flip classrooms.

6.1.3.Limitations and Future Research

This study has a few limitations as well. This study has been conducted in Chinese universities randomly and it involved postgraduate students. No specific department or university was selected for this research purpose. It relied on a questionnaire method to get the response of students about flip learning. It remained limited to students' responses only. Teachers were not involved in this study to find their points of view. The practical application of Flipped classrooms is also missing where online lectures must be delivered to students. Long-duration video lectures must be provided to view the student's response in a more detailed way. In this study, random students were selected which can give some obstacles in presenting the final results. All students are not comfortable with the digital era and use of technology so we should not select the students unknowingly instead we must focus on those students who are comfortable using technology for learning purposes. We can also use qualitative methods by which students' or teachers' responses can be observed through interviews which is also a great way to record the role of flipped learning in students' mental health. We can increase or decrease our sample size to see the fluctuations in the results.

For future studies, scholars should study flipped learning by combining it with some other teaching approaches. In the future, the studies can also focus on some other variables like students' motivation and achievement of the set learning outcomes. Similarly, the moderating role of comfort to the technology of (students and teachers) can also be studied in future research. Future studies should look into the potential effects of other video styles. Even while using recorded lectures on video is becoming more and more common, we still know very little about how various video formats could affect students' learning. Additionally, longitudinal research should be carried out to look if a flipped classroom strategy can develop retention of knowledge over an extended length of time.

Authors Contribution

Hafizah Mat Nawi: Complete the initial draft, incorporate the comments and finalize the draft.

Conflict of Interests/Disclosures

The authors declared no potential conflicts of interest w.r.t the research, authorship and/or publication of this article.

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