The relationship between digital literacy and academic performance of college students in blended learning: the mediating effect of learning adaptability

Wenzheng Wu[1,a], Lingmin Yuan[1,b,*]

[1]College of Physics and Electronic Engineering, Sichuan Normal University, Chengdu, 610101, China
[a]wenzheng.w@foxmail.com, [b]yuanlingmin@sicnu.edu.cn
*Corresponding author

Abstract: Blended learning is one of the main learning modes for college students nowadays. However, the relationship between college students' digital literacy, learning adaptability, and their academic performance in the blended learning environment has not been revealed in known studies. This study explores the impact of digital literacy on college students' academic performance, as well as the mediating role of college students' learning adaptability between the two variables. Based on previous literature, this study uses a structural equation model to verify the corresponding hypotheses and tests the mediating effect based on data from 357 participants. This study reveals that in blended learning environment, college students' digital literacy has a significant direct impact on their academic performance, college students' learning adaptability can also positively influence their academic performance, and learning adaptability plays a partially mediating role between digital literacy and academic performance in the blended learning environment. These results are discussed and provided suggestions for college students' blended learning and future research.

1. Introduction

Since the 21st century, blended learning, a new learning mode, has attracted the attention of a large number of educational researchers and teachers and has gradually become a new trend. Typically, what is known as blended learning is the thoughtful combination of face-to-face learning experiences in the classroom with online learning experiences[1] After a long period of theoretical research and practice, blended learning has achieved good teaching results and has been applied in higher education classrooms around the world. For university students, it can be argued that there is a correlation between the quality of learning and learning adaptability, and it is clear that the learning adaptability of university students also has an impact on academic performance[2,3]. While technology is beneficial to some extent, its negative impact on college students' learning in higher education cannot be ignored. Some surveys have shown that using various digital technologies for

learning can cause test anxiety and loneliness in learners[4], they may exhibit some maladaptive behaviors. On the whole, most college students accept and approve of blended learning, and the survey shows that their learning adaptability is good. However, there are fewer studies on the relationship between learning adaptability and academic performance of college students in a blended learning environment.

It cannot be ignored that digitally literate learners are better able to use and benefit from digital devices for learning, and that positive attitudes and interests can make such learners more comfortable with technology-supported learning environments. Thus, to some extent, digital literacy positively affects learners' learning adaptability, and the above relationship was confirmed in empirical studies[5]. Some of the relationships between digital literacy, learning adaptability, and academic performance have been described and confirmed in a review of previous literature. However, to our knowledge, there has not yet been an investigation into the impact of college students' digital literacy and learning adaptability on academic performance in a blended learning environment. Therefore, the main research objectives of this study were to investigate the effects of digital literacy and learning adaptability on academic performance of college students in a blended learning environment and to examine the mediating role of learning adaptability between the two. Firstly, the hypotheses of this study were formulated based on previous studies; secondly, based on previous studies, the existing scales were adapted or adjusted according to the actual situation of this study, and then college students were recruited to fill in the scales, and then the data were statistically analyzed; finally, structural equation modeling was used to simulate and analyze the possible relationship between the above three and to test whether the mediating effect exists.

2. Literature review and research hypotheses

2.1. Digital literacy

Digital literacy, initially, refers to people's cognitive awareness of online information[6]. Later, a more comprehensive and well-known global digital literacy framework was proposed by Eshet-Alkalai, which further elaborated that digital literacy is a complex thinking ability involving cognitive, motor, and social skills; he argued that digital literacy mainly includes five elements such as emotional-cognitive literacy, picture visual literacy, etc., which is summarized as the user's ability beyond operating the appropriate devices and software[7]. This definition is consistent with Gilster's original definition[8]. Eshet-Alkalai later added the Real-Time thinking literacy to it, thus forming a comprehensive digital literacy framework with six elements[9], and considered digital literacy as a skill necessary for people to survive in the digital age[7,9].

This study will use Eshet-Alkalai's digital literacy framework as a benchmark for two reasons. First, Eshet-Alkalai's digital literacy framework was proposed earlier and it comprehensively evaluate the digital literacy level of the subjects. Second, the scale developed based on this digital literacy framework has shown good reliability and validity in previous studies[8], and can objectively reflect the digital literacy of the subjects to a certain extent.

2.2. Learning adaptability

In the dictionary of the American Psychological Association, the term adaptability is defined as the capacity to make appropriate responses to changed or changing situations. Next, learning adaptability is derived from adaptability and is mainly within the research scope of educational psychology. It is the physiological and psychological adjustments that learners make in response to different situations during the learning process.

The survey of students' perceptions of blended learning found that most of them gave it a high

rating, and it can be seen that the learning adaptability situation is good[10]. And recent studies have revealed that college students show better learning adaptability in blended learning[11]. However, some adult learners do not perform well in blended learning and they prefer traditional learning styles[12].

Affected by COVID-19, some universities have adopted a blended teaching approach to cope with teaching tasks during the pandemic. During and after this period, blended learning has become one of the main learning methods for college students. Therefore, this paper investigates and studies the adaptability of college students in a blended learning environment.

2.3. Academic performance

Generally speaking, the academic performance of learners is reflected by measuring the results achieved by students in various subjects. Academic performance is the result of education and, in the case of students, the learning goals to be achieved over a period of time. Some researchers can measure academic performance through exams or long-term assessments[13], and it is usually represented visually by a student's GPA[14].

Obviously, school, as the primary place of learning for students, can have an impact on students' academic performance. In addition, teachers, the most critical personnel in schools, have an impact on students' academic performance[15]; specifically, teachers' behaviour[16], teaching methods and approaches, and subject content and content knowledge storage have an impact on students' academic performance. In this study, self-reporting will be used to assess the academic performance of college students.

2.4. Digital literacy, learning adaptability and academic performance

Based on the literature review above, digital literacy, as defined in this study, consists of six main elements. Previous studies have shown that learners' digital literacy has a positive impact on students' academic performance[17,18]. However, the above research was basically conducted in general learning environments or online learning environments, and did not pay attention to the relationship between digital literacy and academic performance in blended learning environments. Therefore, we propose the following hypothesis: H1. Digital literacy (DL) is positively associated with college students' academic performance (AP).

This study focuses on the learning adaptability of college students in blended learning, or it can be called blended learning adaptability, the ability of individuals to constantly adjust themselves in a constantly changing learning environment that combines online and offline, overcome obstacles, and successfully achieve corresponding learning goals.

Obviously, the level of learning adaptability can have an impact on students' academic performance. Students with better learning adaptability will have higher learning satisfaction in the learning process, and thus will be able to achieve better academic performance or learning outcomes[3].

However, relatively few existing studies have explored the relationship between college students' learning adaptability and academic performance in blended learning environments. Therefore, the hypothesis of the relationship between blended learning adaptability and academic performance is proposed: H2. Learning adaptability (LD) is positively associated with college students' academic performance (AP).

At the same time, research has shown that learners' digital literacy has a certain impact on learners' adaptability to learning[5]. Therefore, based on previous research, this paper further proposes a view that digital literacy will have a certain impact on the learning adaptability of blended learning in a blended learning environment. As a result, this view will be added as a research hypothesis to this

study: H3. Digital literacy (DL) is positively associated with learning adaptability (LD).

2.5. Mediating effect of learning adaptability

Based on previous research, this study proposes the following research hypothesis that learning adaptability can mediate the relationship between digital literacy and students' academic performance in blended learning environment. First, the level of digital literacy has a direct impact on students' academic performance; second, learning adaptability also affects students' academic performance; finally, digital literacy affects students' learning adaptability in blended learning environments, which indirectly affects students' academic performance. Having a higher level of digital literacy will, to some extent, promote students' learning adaptability and students will then be able to achieve better academic performance. As a result, the research hypothesis will be investigated and tested in the current study: H4. Learning adaptability (LD) plays a mediating effect in the relationship between college students' digital literacy and students' academic performance (AP). At this point, all the relationships of the research hypotheses in this study are presented in Figure 1.
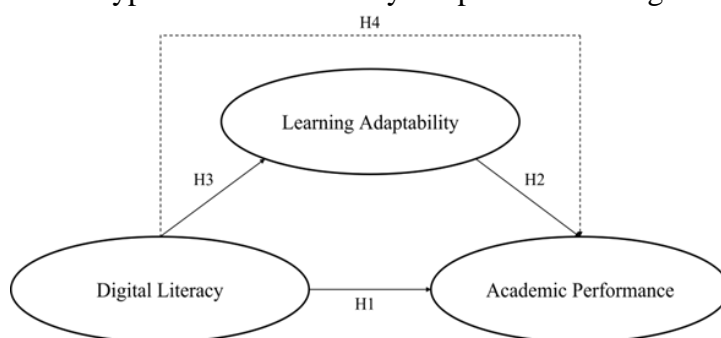
Figure 1: Path diagram related to the study hypothesis.

3. Methods

3.1. Participants

Table 1: Demographic profile.

Items		Number	Percentage
Gender	Female	202	57.5
	Male	149	42.5
Level	Freshmen	99	28.2
	Sophomores	61	17.4
	Juniors	105	29.9
	Seniors	81	23.1
	Postgraduate	5	1.4
Time of exposure to blended learning	1-3 months	89	25.4
	3-6 months	102	29.1
	6-9 months	57	16.2
	9-12 months	25	7.1
	Over 12 months	78	22.2

In this study, we mainly focus on university students. For this purpose, a total of 427 undergraduates and some graduate students from different years were recruited to complete the study. All subjects were informed that the answer data would be used for scientific research and their permission was obtained. During the COVID-19 pandemic, according to the needs of local epidemic

control, students at this college adopted blended learning to study and some subsequent course will also be based on blended learning in the future.

After excluding some unqualified samples, this study used a total of 351 valid data samples for further analysis and processing. The data shows that there are 202 females and 149 males among the subjects, all of whom have participated in blended learning, and most of the time spent in blended learning is more than 3 months (74.6%), as shown in Table 1.

3.2. Data analyses

In this study, data were analyzed mainly through SPSS (27) and AMOS (24) software developed by IBM. SPSS was mainly used for descriptive analysis, reliability of data, etc. In order to explore the relationship between multiple latent variables, including testing whether the mediating effect is significant, etc., the optimal way is to conduct the study using a structural equation model. For example, χ^2, χ^2/df, SRMR, RMSEA, CFI, IFI, TLI. the acceptable threshold values of model fit indicators vary among researchers or studies, for example, a model with χ^2/df<3[19], SRMR<0.08[20], RMSEA<0.08[21],CFI>0.9[22], IFI >0.9[23], TLI>0.9[24]indicates a good fitness. Therefore, this study will use the above criteria as the threshold for assessing whether the model in this study is acceptable. Also, this study will use AMOS software to test the mediating effect between latent variables. The mediating effect in this study was tested by the 2000 bootstrap samples along with 95% confidence intervals. If the confidence interval does not contain 0, the mediating effect is significant [25].

3.3. Measures

3.3.1. Digital literacy

A digital literacy self-assessment scale designed by Porat was used[8], based on the conceptual framework of digital literacy proposed by Eshet-Alkalai, which includes six dimensions: Photo-visual literacy (PV),Reproduction literacy (RE),Branching literacy (BR), Information literacy (IN), Social-Emotional literacy (SE), and Real-Time thinking literacy (RT). In order to meet the actual situation of this study, the scale was translated into Chinese under the guidance of a doctor of education and some of the questions were localized to suit the actual learning and living situation of the test subjects.

To ensure the validity of the questionnaire, a validated factor analysis (CFA) was conducted. In this study, the confirmatory factor analysis results for this scale (χ^2/df=2.875, CFI=0.946, TLI=0.931, IFI=0.947, RMSEA=0.073, SRMR=0.0443) were in the acceptable range. In addition, the factor loadings of PV are between 0.79 and 0.86. The factor loadings for RE are between 0.60 and 0.84, BR is between 0.81 and 0.88, IN is between 0.81 and 0.83, SE is between 0.72 and 0.81, and RT is between 0.62 and 0.69. The factor loadings of each of the above questions are greater than 0.5, and all questions will be retained[26]. According to CFA, the convergent reliability (CR) of each dimension is greater than 0.7, i.e., PV(0.85),RE(0.80),BR(0.88),IN(0.86),SE(0.82),RT(0.71). It indicates a high convergent validity[26,27]. The results of the above validity analysis indicate that the scale has high validity in this study. Meanwhile, in this study, the Cronbach's alpha value of the whole scale was 0.95; in addition, the Cronbach's alpha of each dimension was likewise calculated, PV(0.85), RE(0.80), BR(0.88), IN(0.86), SE(0.82), RT(0.71) [26,27]. All of the above Cronbach's alpha exceeded 0.7, and this result indicates that the scale has high reliability in this study.

3.3.2. Learning adaptability

To investigate the performance of learning adaptability among college students in a blended learning environment, a scale developed by Dr. Qin was used[28]. The scale is based on literature

research, interviews, and theory, and divides the components of learning adaptability into six dimensions, learning attitude (LD), learning task (LT), independent learning ability (IA), learning communication (LC), learning environment (LE), and physical and mental health (PM). The scale is a Chinese version, and some modifications were made to the scale to meet the needs of this study, taking into account the actual learning situation of the subjects.

In this study, the validity of the scale was tested by validating factor analysis. The confirmatory factor analysis results for this scale (χ^2/df=2.541, CFI=0.963, TLI=0.952, IFI=0.963, RMSEA=0.066, SRMR=0.0314) indicated good model fit. Meanwhile, the factor loadings were between 0.81 and 0.88 for LD, between 0.73 and 0.80 for LT, between 0.82 and 0.88 for IA, between 0.75 and 0.80 for LC, between 0.84 and 0.92 for LE, and between 0.56 and 0.90 for PM. The factor loadings of each of the above questions are greater than 0.5, and all questions will be retained[26]. According to CFA, the combined reliability (CR) of each dimension, i.e., LD(0.89), LT(0.82), IA(0.90), LC(0.81), LE(0.90), and RT(0.75). the CR values are all greater than 0.7, indicating a high convergent validity[26,27]. According to the above results, in this study, the scale has high validity. Meanwhile, in this study, the Cronbach's alpha value of the whole scale was 0.57; in addition, the Cronbach's alpha of each dimension was likewise calculated, LD(0.89), LT(0.82), IA(0.90), LC(0.81), LE(0.90), RT(0.74). All of the above Cronbach's alpha exceeded 0.7[26,27],and result indicates that the scale has high reliability in this study.

3.3.3. Academic performance

A self-assessment scale was used to assess the academic performance of college students. The scale developed by Yu is good for assessing the academic performance of college students[29]and has been proved to have good reliability and validity in the rest of the studies. The scale is a unidimensional scale with four question items. Each item is scored on a 5-point Likert scale (1 = strongly disagree; 5 = strongly agree).

Similarly, validation factor analysis (CFA) was conducted to ensure the validity of the questionnaire. The confirmatory factor analysis results for this scale (χ^2/df =1.274, CFI=0.999, TLI=0.998, IFI=0.998, RMSEA=0.028, SRMR=0.0071) indicate a good model fit. Meanwhile, the factor loadings of each question item are between 0.84 and 0.87, which are greater than 0.5, and all question items will be retained[26]. According to the CFA, the combined reliability (CR) value of this dimension is 0.92. The CR value is greater than 0.7[26,27], which indicates a high convergent validity. Also, in this study, the Cronbach's alpha value for the whole scale was 0.92. The Cronbach's alpha exceeded 0.7 [26,27], and this result indicates that the scale has high reliability in this study.

4. Results

4.1. Preliminary analyses

Descriptive statistical analysis of the data was performed using SPSS software. The mean values of each dimension of digital literacy were located in the range of 3.64-4.01, the mean values of each dimension of learning adaptability were located in the range of 3.58-3.77, and the mean value of academic performance was 3.65, all of which were above average (3). Structural equation modeling analysis requires variable data to obey multivariate normal distribution. Related studies have shown that when the skewness of a variable is less than 2 and the kurtosis is less than 7, then the variable satisfies multivariate normal distribution. For details, see Table 2. Obviously, the variables in this study satisfy these conditions. Also, the correlation analysis resulted in significant correlations between the dimensions of digital literacy, the dimensions of learning adaptability, and academic performance. For details, see Table 3.

Table 2: Means, standard deviations, skewness, kurtosis.

	Mean	SD	Skewness	Kurtosis
PV	3.81	0.81	-0.69	1.19
RE	3.87	0.76	-0.55	0.59
BR	3.64	0.83	-0.33	0.41
IN	3.86	0.74	-0.49	0.98
SE	4.01	0.70	-0.74	1.78
RT	3.81	0.75	-0.28	0.56
LD	3.58	0.85	-0.37	0.46
LTA	3.76	0.74	-0.57	1.08
IA	3.73	0.76	-0.63	1.49
LC	3.73	0.76	-0.51	1.18
LEA	3.77	0.78	-0.69	1.33
PM	3.70	0.73	-0.43	1.24
AP	3.65	0.80	-0.35	0.66

Table 3: Correlations of the main study variables.

	1	2	3	4	5	6	7	8	9	10	11	12	13
1.PV	—												
2.RE	0.70**	—											
3.BR	0.64**	0.69**	—										
4.IN	0.68**	0.66**	0.78**	—									
5.SE	0.63**	0.64**	0.59**	0.76**	—								
6.RT	0.55**	0.56**	0.57**	0.67**	0.71**	—							
7.LD	0.41**	0.42**	0.45**	0.49**	0.41**	0.45**	—						
8.LTA	0.51**	0.48**	0.48**	0.57**	0.52**	0.47**	0.68**	—					
9.IA	0.48**	0.46**	0.50**	0.54**	0.50**	0.46**	0.76**	0.77**	—				
10.LC	0.43**	0.45**	0.50**	0.50**	0.45**	0.49**	0.68**	0.68**	0.78**	—			
11.LEA	0.48**	0.45**	0.49**	0.51**	0.51**	0.50**	0.71**	0.72**	0.80**	0.75**	—		
12.PM	0.42**	0.39**	0.48**	0.48**	0.46**	0.48**	0.65**	0.61**	0.73**	0.71**	0.76**	—	
13.AP	0.50**	0.46**	0.60**	0.56**	0.43**	0.55**	0.62**	0.62**	0.67**	0.65**	0.69**	0.63**	—

Note. ** The main difference is significant at the 0.01 level.

4.2. Structural model

Table 4: Path analysis results.

	Estimate	S.E.	C.R.	P
LA←DL	0.68	0.071	10.046	***
AP←LA	0.65	0.079	9.694	***
AP←DL	0.22	0.070	3.929	***

Note. ***p<.001.

To test each of the above research hypotheses, structural equation modeling was used for analysis. The results showed good model fit (χ^2/df=2.541, CFI=0.963, TLI=0.952, IFI=0.963, RMSEA=0.066, SRMR=0.0314). It was found that students' digital literacy had a positive effect on students' academic performance in a blended learning environment (β=0.22, p<0.001), which confirmed our research hypothesis (H1). Similarly, research hypothesis (H2) was confirmed as students' blended learning adaptability also had a positive effect on students' academic performance (β=0.65, p<0.001). In addition, the results of the analysis showed that students' digital literacy positively predicted students' blended learning adaptability to some extent (β=0.68, p<0.001), a result that validated the research

hypothesis (H3). The results of the analysis for each pathway are shown in Table 4.

4.3. Mediation analyses

To test hypothesis (H4), that is, in blended learning, there is a mediating effect of blended learning adaptability between digital literacy and academic performance, Bootstrap sampling of 2,000 times was selected. If the 95% confidence interval does not contain 0, the mediating effect is significant. The results of the test for the mediating effect are shown in Table 5 In this study, the direct effect of digital literacy on academic performance was 0.44 and the indirect effect was 0.22 (95% CI=0.248, 0.443) with a confidence interval that did not contain 0. Therefore, the mediating effect was significant, and hypothesis (H4) was supported. In addition, the direct effect (0.22) accounted for 33.33% of the total effect and the indirect effect (0.44) accounted for 66.67% of the total effect.

Table 5: Analysis of the mediating role of learning adaptability in digital literacy and academic performance in blended learning.

Effect	Effect Size	Boot LLCI	Boot ULCI	Relative Effect Size
Indirect	0.44	0.248	0.637	66.67%
Direct	0.22	0.028	0.443	33.33%
Total	0.66	0.552	0.742	100%

Note. ***p<.001.

The mediating effect analysis shows that students' digital literacy can affect students' academic performance directly or indirectly by affecting students' learning adaptability and thus their academic performance. Since each pathway was significant, blended learning adaptability partially mediated the effect between digital literacy and academic performance.

At this point, the relationships between the variables in this study and the hypotheses were validated, allowing for the construction of the final research model (Figure 2).
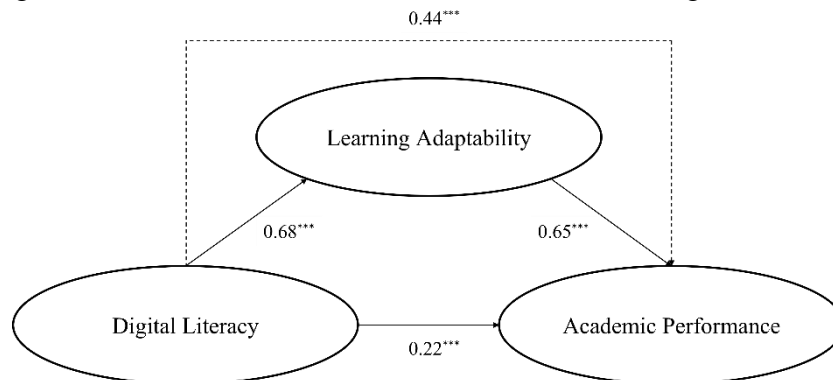

Figure 2: Path analysis depicting direct and indirect effects of variables on each other.

5. Discussion

In the present study, research hypothesis H1 has been confirmed. In a blended learning environment, learners' digital literacy positively affects their academic performance. Digital literacy gets quite high along with better academic performance of the learners. The results of this study are in line with some previous similar studies [17,18]. First, the study showed that learners would benefit more from digital literacy [30]. Second, learners with good study skills typically perform better academically, and digital learning tools will play a more important role in the current or future learning environment.

The second research hypothesis (H2) was to examine the positive effects of learning adaptability

on academic performance. In this study, this hypothesis was also supported. In blended learning environments, the more adaptive learners are, the better academic performance they will achieve. The same results were obtained as in some previous similar studies addressing the relationship between learning adaptability and academic performance [2,3]. In this study, most of the students with good learning adaptability possessed more positive learning attitudes and independent learning abilities, and were better able to complete the corresponding learning tasks. Therefore, for students to be able to achieve better academic performance in the learning process, they need support and assistance in many ways to improve their learning adaptability.

In addition, research hypothesis (H3) was confirmed, illustrating that students' digital literacy positively influences their learning adaptability in blended learning. This yielded the same results as previous similar studies[5]. The blended learning environment consists of both online and offline learning components, especially in the online digital and networked learning sessions, where the support and assistance of digital technology devices are indispensable. Students with higher digital literacy are better able to adapt to the blended learning environment and actively adjust their physical and mental state to meet the learning tasks.

In addition, the research hypothesis (H4) was confirmed due to the presence of mediating effects, that is to say, learners with higher digital literacy will show better learning adaptability and thus benefit more and achieve better academic performance in blended learning environments. This result is similar to the fact that digital literacy positively affects learners' academic performance, with learning attitudes as a mediating quantity[18]. Nowadays, technology has already had a huge impact on various industries, and as digital citizens, they need to be equipped to use digital tools for learning as well as to actively adapt themselves to this future trend in education and actively participate in blended learning, digital learning, and other technology-supported learning styles in order to achieve good academic performance on top of completing their academic tasks.

6. Conclusion, Implication and Limitation

Based on previous literature research, this study constructed a hypothetical model to investigate the relationship between college students' digital literacy, learning adaptability and academic performance in a blended learning environment. Then, based on the survey data, this study used structural equation modeling to analyse the following conclusions: first, both digital literacy and learning adaptability of college students have a significant positive impact on academic performance in a blended learning environment; second, learning adaptability plays a partially mediating role between digital literacy and academic performance. Further, in blended learning, improving college students' digital literacy can lead to better academic performance, and at the same time, the improvement of digital literacy corresponds to the increase of learning adaptability, which can also improve college students' academic performance to some extent.

6.1. Limitation and further directions

Although this study has confirmed some of the previously proposed hypotheses, it still has some limitations. First, the subjects in this study were all from the same university, and subjects from different schools or different regions were not recruited to participate in the survey. Further studies need to consider recruiting more groups with diverse backgrounds or from diverse regions that are not limited to China. On this basis, the results of this study will be further generalized and validated. Second, this study used self-assessment scales to investigate college students' digital literacy, learning adaptability, and academic performance in a blended learning environment. The self-assessment scales have certain drawbacks and are subjectively influenced by the subjects, such as personal bias and tendency of thinking.

6.2. Implication

This study reveals that the academic performance of college students in blended learning is influenced by students' digital literacy and learning adaptability. Meanwhile, this study will bring some unmissable insights in the next part.

First, it can be found in this research study that college students' digital literacy is generally at a moderate level. This is because the college students in this batch are "digital natives"[31], and they have many opportunities to access and use various digital technologies to do what they want to do during their growth. In particular, the proliferation of smartphones and mobile Internet has also lowered the barriers. However, limited by prior learning experiences and differences in individual inclinations, some college students are not yet able to appropriately use various types of digital technology devices in their studies, which indicates that the digital literacy of college students still needs to be improved.

Second, we strive to build a student-friendly blended learning environment. Blended learning is not simply a combination of digital tools and traditional offline face-to-face learning[32], but should take advantage of the respective strengths of online and offline learning. In order to maximize these advantages, support from school administrators or government agencies is needed. Meanwhile, when designing a blended learning course, teachers should fully consider all factors, including students' learning adaptability, to optimize the teaching process.

Acknowledgements

References

[1] Garrison, D. R., & Kanuka, H. (2004) Blended learning: Uncovering its transformative potential in higher education. The Internet and Higher Education, 7(2), 95–105.

[2] Liem, G. A. D. (2019) Academic performance and assessment. Educational Psychology, 39(6), 705–708.

[3] Liu, G. (2022) Research on the Relationship between Students' Learning Adaptability and Learning Satisfaction under the Mobile Media Environment. International Journal of Emerging Technologies in Learning, 17(2), 43–58.

[4] Truzoli, R., Viganà, C., Galmozzi, P. G., & Reed, P. (2020) Problematic internet use and study motivation in higher education. Journal of Computer Assisted Learning, 36(4), 480–486.

[5] Kun W. (2021) ICT Self-Efficacy and Learning Adaptation:Moderated Mediation Model [Master dissertation, Central China Normal University].

[6] Gilster, P. (1997) Digital literacy. John Wiley & Sons, Inc.

[7] Eshet-Alkalai, Y. (2004) Digital Literacy: A Conceptual Framework for Survival Skills in the Digital era. Journal of Educational Multimedia and Hypermedia.

[8] Porat, E., Blau, I., & Barak, A. (2018) Measuring digital literacies: Junior high-school students' perceived competencies versus actual performance. Computers & Education, 126, 23–36.

[9] Eshet-Alkalai, Y. (2012) Thinking in the Digital Era: A Revised Model for Digital Literacy. Issues in Informing Science and Information Technology, 9, 267–276.

[10] Akkoyunlu, B., & Soylu, M. Y. (2008) A Study of Student's Perceptions in a Blended Learning Environment Based on Different Learning Styles. Journal of Educational Technology & Society, 11(1), 183–193.

[11] Ang, J. W. J., & Ng, Y. N. (2022) Effect of Research-Based Blended Learning with Scrum Methodology on Learners' Perception and Motivation in a Laboratory Course. Journal of Chemical Education, 99(12), 4102–4108.

[12] Vanslambrouck, S., Zhu, C., Pynoo, B., Thomas, V., Lombaerts, K., & Tondeur, J. (2019) An in-depth analysis of adult students in blended environments: Do they regulate their learning in an 'old school' way? Computers & Education, 128, 75–87.

[13] Narad, A., & Abdullah, B. (2016) Academic Performance of Senior Secondary School Students: Influence of Parental Encouragement and School Environment. Rupkatha Journal on Interdisciplinary Studies in Humanities, 8(2), 12–19.

[14] Davison, C. B., & Dustova, G. (2017) A Quantitative Assessment of Student Performance and Examination Format. Journal of Instructional Pedagogies, 18.

[15] Baafi, R. (2020) School Physical Environment and Student Academic Performance. Advances in Physical Education, 10, 121–137.

[16] Rashid, M., & Zaman, S. (2018) Effects of Teacher's Behavior on Academic Performance of Students. 1–15.

[17] Abbas, Q., Hussain, D., & Rasool, S. (2019) Digital Literacy Effect on the Academic Performance of Students at Higher Education Level in Pakistan. Global Social Sciences Review, IV(1), 154–165.

[18] Mehrvarz, M., Heidari, E., Farrokhnia, M., & Noroozi, O. (2021) The mediating role of digital informal learning in the relationship between students' digital competence and their academic performance. Computers & Education, 167.

[19] Hayduk, L. A. (1987) Structural equation modeling with LISREL: Essentials and advances (pp. xvii, 405). Johns Hopkins University Press.

[20] Hu, L., & Bentler, P. M. (1998) Fit indices in covariance structure modeling: Sensitivity to underparameterized model misspecification. Psychological Methods, 3, 424–453.

[21] Browne, M. W., & Cudeck, R. (1992) Alternative Ways of Assessing Model Fit. Sociological Methods & Research, 21(2), 230–258.

[22] Bagozzi, R. P., & Yi, Y. (1988) On the evaluation of structural equation models. Journal of the Academy of Marketing Science, 16(1), 74–94.

[23] Kline, R. B. (2016) Principles and practice of structural equation modeling, 4th ed (pp. xvii, 534). Guilford Press.

[24] Hair Jr., J. F., Babin, B. J., & Krey, N. (2017) Covariance-based structural equation modeling in the Journal of Advertising: Review and recommendations. Journal of Advertising, 46, 163–177.

[25] Preacher, K. J., & Hayes, A. F. (2008) Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. Behavior Research Methods, 40(3), 879–891.

[26] Hair, J. F., Sarstedt, M., Ringle, C. M., & Mena, J. A. (2012) An assessment of the use of partial least squares structural equation modeling in marketing research. Journal of the Academy of Marketing Science, 40(3), 414–433.

[27] Fornell, C., & Larcker, D. F. (1981) Evaluating structural equation models with unobservable variables and measurement error. Journal of Marketing Research, 18, 39–50.

[28] Jinruo Q. (2019) Research on the influencing factors and intervention of blended learning adaptability of college students based on MOOC [Doctoral dissertation, Shaanxi Normal University].

[29] Yu, A. Y., Tian, S. W., Vogel, D., & Kwok, R. C.-W. (2010) Can learning be virtually boosted? An investigation of online social networking impacts. Computers & Education, 55, 1494–1503.

[30] Pagani, L., Argentin, G., Gui, M., & Stanca, L. (2016) The impact of digital skills on educational outcomes: Evidence from performance tests. Educational Studies, 42(2), 137–162.

[31] Prensky, M. (2001) Digital Natives, Digital Immigrants Part 1. On the Horizon, 9(5), 1–6.

[32] Vaughan, P. N. D., Reali, A., Stenbom, S., Vuuren, M. J. V., & MacDonald, D. (2017) Blended Learning From Design to Evaluation: International Case Studies of Evidence-Based Practice. Online Learning, 21(3), Article 3.