



Research article

Is better readiness the key to deeper learning in distance education? A cross-sectional online study

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ABSTRACT

Background: The COVID-19 pandemic has required teachers and students to suddenly transition from face-to-face formats to distance education (DE). The uniqueness of nursing discipline is that it requires both theoretical and skills-based learning. Therefore, it is necessary to explore the influencing factors and effectiveness of DE in nursing education. This exploration can guide teaching practice and provide a basis for the future application of DE in nursing education.

Aims: To describe the current distance education readiness and depth of learning among undergraduate nursing students and explore possible influencing factors. To determine the relationship between students' distance education readiness and the depth of learning.

Design: This is a descriptive and cross-sectional online study.

Settings: School of Nursing in a traditional Chinese medicine university, Beijing, China.

Participants: A total of 222 undergraduate nursing students from a traditional Chinese medicine university were recruited.

Methods: A questionnaire, which is composed of information form, the Online Learning Readiness Scale, and the Scale of Students Making Deep Learning, was used for data collection. Frequency, percentage, arithmetic mean, standard deviation, *t*-test, one-way ANOVA, and Pearson correlations were used in the analysis of the data.

Result: Undergraduate nursing students have lower averages in distance education readiness and higher averages in the depth of learning. Significant differences in distance education readiness and depth of learning between different grade groups. A positive correlation was found between distance education readiness and depth of learning ($r = 0.894, p < 0.001$).

Conclusion: Distance education is a feasible approach to learning today. Undergraduate nursing students have exhibited poor readiness for distance education but demonstrated deeper learning conditions. Upper grades may lead to better learning outcomes. Better distance education readiness can lead to deeper learning. These conclusions prompt teachers and students to be prepared before participating in distance education to obtain better academic performance.

1. Introduction

The World Health Organization (WHO) declared the novel coronavirus disease 2019 (COVID-19) as a public health emergency of international concern and a global pandemic in 2020 [1]. It has influenced the development and implementation of education in

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various ways. Governments and educational institutions around the world have adopted appropriate measures to deal with this situation. Among all measures, distance education (DE) is the easiest and most widely applicable teaching method. DE is defined by The Asian Association of Open Universities as institution-based, formal education where the learning group is separated, and interactive telecommunications systems are used to connect learners, resources, and instructors. The advantages of DE have been proven in many studies. Its flexibility is its most outstanding benefit, allowing students to overcome distance limitations and access classes conveniently. DE enables students to study in a more comfortable environment and facilitates communication and interaction between students and teachers through technology [2]. Therefore, this form of teaching-learning method has been commonly implemented in many countries such as the USA, Australia, and Canada [3,4]. Although its technology and applications are relatively mature, it is still not used on a large scale in regular teaching.

Undergraduate nursing education aims to prepare nursing students with theoretical knowledge and clinical competence. What distinguishes it from other disciplines is that it focuses more on theoretical knowledge. Nursing emphasizes apprenticeship, operations, concepts, and practice. Studies have proven that the advantages of DE in nursing teaching are that it is easier and faster to transfer theoretical knowledge, and that students can attend courses anytime and anywhere they have access to the Internet and equipment. The disadvantages of DE are also obvious. The communication between teachers to students and students to students is reduced [5]. The professors would lose to observe students' reactions towards the course contents. Moreover, studies have also shown that DE is insufficient for cultivating clinical competence.

Theoretical knowledge is the basis of clinical practice which plays an irreplaceable role in nursing education. The development of the nursing discipline in developing countries needs more technology integration to improve the professional competence of nursing staff and better combine practice and theory [6]. Therefore, exploring the impact of DE on nursing students can promote a better combination of distance education and offline education in the future, which is conducive to saving manpower and time and making students' learning more efficient.

The Australian vocational education and training sector first introduced the concept of readiness for online learning [7]. It is suggested that readiness for online learning is constructed by computer skills, internet self-efficacy, self-direction, motivation, interaction, and attitude [8]. Students' readiness for online learning is an important influence on learning outcomes. Hung's [9] study has shown that students' intrinsic or extrinsic motivation has significant effects on the student's learning performance. Students have a positive attitude towards DE, and there is a positive correlation between students' computer skills and their readiness to implement Internet-based distance education [10].

The self-efficacy definition derives from social cognitive theory, which explains how self-efficacy beliefs regulate human functioning through cognitive, motivational, affective, and decisional processes [11,12]. Since DE is mostly conducted through the medium of computers and networks, it would be necessary to explore students' computer network self-efficacy, which is students' perceptions of DE and their ability to use online technology. Similarly, computer-mediated communication self-efficacy is crucial as well. Study findings indicate that it is important to create opportunities for students to communicate with teachers and other students, and successful students should interact with and discuss more in online courses [13]. In addition, encouragement and feedback from teachers are needed to prevent students' interests from burning out when learning online [9].

This study aims to assess the readiness of undergraduate nursing students in distance education and how effective distance education is in theoretical learning.

This study was guided by the following research questions: 1) What are the levels of online learning readiness among undergraduate nursing students? 2) What is the depth of learning levels of undergraduate nursing students? 3) What are the influencing factors of depth of learning? 4) What is the relationship between depth of learning and online learning readiness?

2. Methods

2.1. Sample, design, and setting

This is a descriptive cross-sectional study. It followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) Statements Guidelines for reporting observational studies [14].

Cluster sampling was adopted to identify the participants. Cluster sampling is a nonrandom sampling technique that involves selecting intact groups or clusters as the units of analysis, rather than individual participants. By studying intact groups, we can better understand the impact of online learning on the depth of learning within the specific context of nursing education.

The inclusion criteria were as follows: (1) participants must be currently enrolled undergraduate nursing students; (2) participants must have completed online courses during the previous academic year; (3) the participants must have signed the written informed consent. The exclusion criteria were as follows: (1) participants who have taken a formal leave of absence from their education; (2) participants who have not adhered to the teaching process established by the school. Online questionnaires were distributed to participants. A total of 224 participants responded to the questionnaire. However, two participants provided incomplete responses, rendering their submissions invalid. Consequently, the final dataset comprised 222 valid questionnaires, which were utilized for analysis.

2.2. Data collection

Institutional review board approval to conduct the study was obtained from the Beijing University of Chinese Medicine (2020BZYLL0807). The online study was conducted using the professional online survey software named Questionnaire Star Software

(<https://www.wjx.cn/app/survey.aspx>) in China. It generated a survey link and a Quick Response code that could be accessed from mobile phones or computers. Participants received the survey link or Quick Response code via WeChat (the most commonly used social application in China). Both ways can open the questionnaire.

The academic advisors of potential participants were directly contacted to reach the participants. Advisors were asked to assist in identifying and contacting eligible nursing students who may be interested in participating in the study. Nursing students who expressed interest in participating would have been provided with instructions on how to contact the researchers directly. This process ensures that potential participants have a clear understanding of the study and can make an informed decision about participation. The purpose and procedures of the study were explained on the front page of the questionnaire. It also assured that participants' personal information will remain confidential and participation is optional. Before the start of the study, the participant was asked to sign an informed consent. In addition, the researcher's contact information is provided in case the participants have any concerns. The researchers collected responses via the online system and stored them in digitally encrypted form.

2.3. Instruments

The components of the entire questionnaire include the information form, the Online Learning Readiness Scale (OLRS), and the Scale of Students Making Deep Learning (SSMDL).

The information form was designed by the researchers in line with the literature and consists of 2 parts and 8 questions [9,15–17]. The first part contains questions about the participants' demographic characteristics (age, gender, grade, and whether to serve as a student leader). The second part consists of questions regarding participants' distance education experiences (daily online learning time, how many courses were taken online in the past year, online learning equipment used, and synchronous or non-synchronous courses).

The Online Learning Readiness Scale (OLRS) [9] is a 5-point Likert-type scale which consists of 18 items (1-Strongly Disagree, 5-Strongly Agree) and was developed by Minling Hung et al., in 2010. The scale contains 5 subdimensions (computer/internet self-efficacy, self-directed learning, learner control, motivation for learning, online communication self-efficacy) which help to investigate participants' readiness in distance education. Higher scores indicate better readiness for online learning. In the original study, the reliability of each dimension of the scale ranges from 0.727 to 0.871, which indicates good reliability. The convergent and discriminant validities of the constructs of the OLRS model are also acceptable. Two language experts were invited to translate the questionnaire into Chinese separately, and two university students helped to determine the suitability of the final questionnaire for the current circumstance. To check the quality of the scale, Cronbach's alpha coefficient was used to determine the scale's internal reliability after the data collection. The 18-item scale's reliability was 0.974. Therefore, the OLRS was shown to have more than decent internal consistency reliability.

The Scale of Students Making Deep Learning (SSMDL) [18] was used to assess participants' depth of learning and knowledge acquisition in DE. The 5-point Likert type scale consists of 27 items (1-Strongly Disagree, 5-Strongly Agree) developed by Jinjuan Tang in 2011. It contains 4 areas of competence (information literacy, knowledge construction, knowledge reprocessing, and communication). Higher scores mean deeper learning. The Cronbach's alpha value was 0.8743 in the original scale, which indicates good reliability. The Bartlett test result ($p < 0.001$) proved good validity. After the data collection, Cronbach's alpha coefficient was used to determine the scale's internal reliability. The Cronbach's alpha was 0.984 which proved that the SSMDL have good internal reliability.

Table 1
Descriptive characteristics of undergraduate nursing students (n = 222).

Characteristics	n	%	
Gender	Female	192	86.5
	Male	30	13.5
Grade	Sophomore	190	85.6
	Junior	19	8.6
	Senior	13	5.9
Student leader	Yes	79	35.6
	No	143	64.4
Daily DE time	<2 h	32	14.4
	2~4 h	42	18.9
	>4 h	148	66.7
DE course ratio	Less than a half	54	24.3
	half	98	44.1
	More than half	57	25.7
	All	13	5.9
Equipment	Smartphone	21	9.5
	tablet	39	17.6
	Laptop or desktop computer	162	73
Course form	Synchronous courses	209	94.1
	Non-synchronous courses	13	5.9

2.4. Data analysis

All analyses were carried out using SPSS software (version 20), and the statistical significance value was set at $p < 0.05$. Frequencies, percentages, arithmetic means, and standard deviations were used to describe the characteristics of participants. The t -test was employed to assess differences in readiness and depth of learning between participants and the norm. The t -test, and one-way ANOVA test were used to explore the factors affecting undergraduate nursing students' online learning readiness and depth of learning. Pearson correlations were conducted to reveal the correlation between online learning readiness and depth of learning.

3. Result

The mean age of the students was 19.41(1.048 years) (min: 18, max: 28, median: 19). Their descriptive characteristics are shown in Table 1.

What stands out in the table is that the majority of participants were female (86.5 %), mainly because nursing students are predominantly female. Sophomore students account for 85.6 % of the total. More than half of the students have more than 4 h of DE time per working day. Seventy-three percent of students use a laptop or desktop computer instead of a phone or tablet for DE. The vast majority of students participate in DE based on synchronous courses.

3.1. Findings regarding undergraduate nurse students' online learning readiness

222 participants were assessed for their readiness for online learning, and their mean OLR score was determined as 3.58(0.788) (min: 1, max: 5). The subdimension mean scores of the OLR are shown in Table 2. As the table shows, there are significant differences between the two groups ($P < 0.05$). It can be seen that participants have lower online learning readiness than the norm in all 5 subdimensions.

3.2. Findings regarding undergraduate nurse students' depth of learning

Turning now to the score of deep learning. The participants' SSMDL mean score was 3.41(0.822) (min: 1, max: 5). The subdimension mean scores and comparison with the norm are shown in Table 3. Interestingly, it shows that except for the aspect of information literacy, the participants obtained a higher score than the norm in the other three aspects, which indicates that the participants have deeper learning level than the general university population.

3.3. Findings regarding factors affecting undergraduate nurse students' online learning readiness and depth of learning

In the analysis of influencing factors of DE readiness and depth of learning, we can only see significant differences in grades. Senior students have better readiness in DE than sophomore students ($p < 0.001$). Regarding the depth of learning, senior students also showed deeper learning level than sophomores ($p < 0.001$) and junior students($p = 0.002$). The result doesn't show a difference in other possible influencing factors, which has shown in Table 4.

3.4. Relation between online learning readiness and depth of learning

A strong positive correlation was found between online learning readiness and depth of learning ($r = 0.894, p = 0.000$), which indicates the better readiness in DE, the greater the depth of learning (Fig. 1).

4. Discussion

4.1. Possible reasons for low readiness of DE in undergraduate nursing students

An initial objective of the study was to identify undergraduate nursing students' readiness for DE learning. The results showed that

Table 2
Relation between undergraduate nursing students' mean OLR scores and the norm (n = 222).

Dimensions	Mean(SD)		t	p
	norm	study		
Computer/Internet self-efficacy	4.37(0.602)	3.62(0.938)	-11.860	<0.001**
Self-directed learning	3.75(0.654)	3.56(0.825)	-3.426	0.001**
Learner control	3.60(0.715)	3.42(0.875)	-3.008	0.003**
Motivation for learning	4.01(0.593)	3.66(0.810)	-6.519	<0.001**
Online communication self-efficacy	3.93(0.673)	3.64(0.873)	-4.827	<0.001**

Notes: SD: Standard deviation, t: t -test, p: Significant value, ** $p < 0.01$; Norm: Standardized values obtained by scale designers based on testing a large number of target populations. It can be representative of the general OLR score in university students.

Table 3
Relation between undergraduate nursing students' mean SSMDL scores and the norm (n = 222).

Dimensions	Mean(SD)		t	p
	norm	study		
Information literacy	3.58(0.714)	3.56(0.835)	-0.367	0.714
Knowledge construction	2.88(0.823)	3.29(0.905)	6.931	<0.001**
Knowledge reprocessing	3.19(0.759)	3.41(0.845)	5.616	<0.001**
Communication	3.09(0.830)	3.31(0.912)	2.042	0.042*

Notes: SD: Standard deviation, t: t-test, p: Significant value, *p < 0.05, **p < 0.01; Norm: Standardized values obtained by scale designers based on testing a large number of target populations. It can be representative of the general depth of learning in the university population.

Table 4
Factors affecting undergraduate nursing students' online learning readiness and depth of learning.

	Online learning readiness			Depth of learning		
	Mean(SD)	Statistics	p	Mean(SD)	Statistics	p
Gender		1.571 ^a	0.118		1.213 ^a	0.226
Male	3.37(0.854)			3.24(0.790)		
Female	3.61(0.774)			3.43(0.826)		
Grade		7.177 ^b	0.001^c		9.305 ^b	<0.001^c
Sophomore	3.51(0.795)			3.34(0.814)		
Junior	3.77(0.591)			3.41(0.726)		
Senior	4.31(0.481)			4.32(0.496)		
Student leader		-0.038 ^a	0.970		-0.013 ^a	0.990
Yes	3.58(0.842)			3.41(0.808)		
No	3.59(0.759)			3.41(0.833)		
Daily learning time		0.542 ^b	0.582		0.776 ^b	0.462
< 2 h	3.69(0.936)			3.57(0.919)		
2 h-4h	3.63(0.674)			3.41(0.694)		
>4 h	3.55(0.786)			3.37(0.834)		
DE course ratio		1.947 ^b	0.123		1.307 ^b	0.273
Less than a half	3.54(0.739)			3.34(0.818)		
Half	3.72(0.764)			3.53(0.784)		
More than half	3.45(0.805)			3.30(0.849)		
All	3.35(0.989)			3.24(0.822)		
Equipment		0.842 ^b	0.432		1.039 ^b	0.356
Smartphone	3.40(7.24)			3.19(0.855)		
Tablet	3.52(0.849)			3.35(0.811)		
Laptop or desktop computer	3.62(0.781)			3.45(0.820)		
Course form		0.331 ^a	0.741		0.656 ^a	0.512
Synchronous courses	3.65(0.990)			3.55(1.081)		
Non-synchronous courses	3.58(0.776)			3.40(0.806)		

Notes: p: Significant value.

^a t-test.

^b One Way ANOVA.

^c p < 0.01.

222 participants had lower readiness than the norm in all 5 subdimensions. A possible explanation for these results may be the lack of adequate preparation for DE courses. Prior studies have noted that online learners' experiences can be affected by obstacles such as a lack of technological literacy or loss of time due to malfunctions in electronic systems [19].

At the beginning of the COVID-19 pandemic, the teaching method for university students suddenly switched from face-to-face to an online format. Neither the students nor the teachers have been systematically trained in web technologies and applications before the DE activity began. They both have varying levels of computer skills. Students expressed the need for teachers to make some changes in their teaching techniques when converting face-to-face instruction to online instruction [20]. Moreover, students and teachers are located in different areas, and the stability of the network varies. These reasons lead to students' low computer/Internet self-efficacy, thus reducing their online communication self-efficacy at the same time. Another possible explanation for low readiness is that due to the recurrence of the epidemic, students' learning formats switched back and forth between online and offline. Lin's [21] study proved that the success of online learning depends largely on the student's ability to learn at their own pace and pursue their goals. Therefore, switching learning formats frequently may disrupt the student's pace of learning which causes a low score in the self-directed learning subdimension.

In addition, there are many disadvantages to online learning, including monotonous lecture formats, teachers not being able to observe students' reactions and feedback to class content [5], students being easily distracted when learning through electronic devices, etc. These factors can lead to laziness, boredom, and poor independence in students which can also reduce students' motivation for learning. It explains the low learner control score of subjects as well.

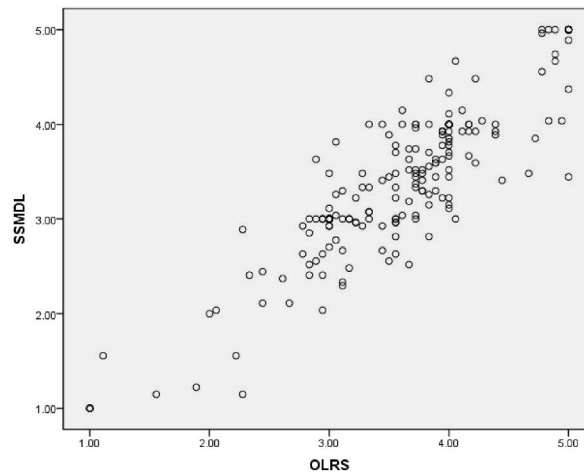


Fig. 1. Relationship between online learning readiness and depth of learning.

Students' online learning readiness is considered to be one of the prerequisites for a successful learning process and educational achievement [22]. It is important in affecting the willingness of students' participation in class and the quality of online learning [23]. Students who possess the necessary skills and attributes to succeed in online courses, such as self-regulation, self-motivation, and technical skills, are more likely to thrive in a digital learning environment. This study showed that the majority of undergraduate nursing students did not reach an average level of readiness for online learning, demonstrating that the school should do appropriate training to improve readiness before distance education. This will enable students to be well prepared for distance learning, to adapt to the learning method more quickly, and to become more involved in the learning itself.

4.2. Depth of learning in undergraduate nursing students

On the question of deep learning in DE, this study found that except for the aspect of information literacy, which showed no significant difference from the norm ($p = 0.714$), the participants obtained higher scores in the other 3 aspects. Interestingly, the depth of learning presents the opposite result compared to learning readiness. A study reported that DE is suitable for theoretical courses in nursing education; however, it also stated that DE is not sufficient for gaining skills and that face-to-face lessons should be conducted to accomplish the teaching objectives [15]. Therefore, this rather contradictory result may be due to most of our participants being sophomore students. There are more theoretical lessons rather than skills lessons, so the knowledge structure is relatively clearer and easier to master. Therefore, under such conditions, students can achieve deep learning.

The depth of learning can represent the effectiveness of learning to a certain extent. In turn, appropriate support and preparation provided by educators can ensure that students acquire knowledge effectively and ensure continued interest [24].

4.3. Influencing factors of online learning readiness and depth of learning

Contrary to expectations, this study did not find a significant difference in learning readiness and depth of learning among other demographic or educational-related factors. Previous studies have indicated that factors such as being a student leader, possessing better learning equipment, and participating in synchronous courses could enhance learning effectiveness [25]. Therefore, further research is needed, with a larger sample size, to explore the relationship between these variables. The only significant difference was found between grades. The senior students exhibited better online learning readiness and depth of learning. This demonstrates that senior students possess a strong mastery of information technology and learning methodologies. With several years of online learning experience, they are more familiar with DE, enabling them to easily grasp knowledge and understand the teacher's intentions. However, given the limited sample size of senior students, caution must be applied, as the findings might not be highly valid. Further research is necessary to determine role of grades in these two areas.

4.4. Correlation between online learning readiness and depth of learning

The most valuable pedagogically relevant finding is the positive correlation between readiness and depth of learning. The observed correlation might be explained in this way: studies have reported that students' internet self-efficacy, motivation for learning, self-directed learning ability, and learner control could all affect students' knowledge acquisition and academic performance to some extent [9]. Therefore, the depth of learning also increases with the level of learning readiness.

4.5. Implications

Due to the unique characteristics of the nursing profession, distance education puts a damper on student-patient interaction and skill acquisition, which can also raise concerns about students' lack of preparation before entering their careers [26]. Research has shown that student readiness for online learning is a mediating mechanism between distance education perceptions and learning effectiveness [27,28]. The findings of this study can help us to understand the components of online learning readiness. In the future, we could improve students' readiness for distance education in these dimensions and provide impetus in this intermediary mechanism to help undergraduate nursing students in practice learn theoretical knowledge. Among these dimensions, student motivation plays a crucial role in the formation of learning outcomes, which is consistent with the findings of previous studies [29,30].

This study will also make educational institutions and university faculty aware of the importance of readiness, and that the depth and effectiveness of learning are very much influenced by readiness. The development of students' knowledge does not occur in isolation but requires the support of the environment. The role of the teacher is important in influencing students' self-determination and educational outcomes in the educational environment [30]. Research has proven that if the teacher's readiness is inadequate, it indirectly affects the readiness of the students [31]. Thus, it also affects learning efficiency and mastery of knowledge. The success of distance education also depends on the ability and skills of teachers to adapt to the online learning environment.

DE is not a newly emerging form of learning, but its widespread application among undergraduates is a new attempt in recent years in China. The study addresses the timely issue of transitioning from face-to-face education to distance education due to the COVID-19 pandemic. This context adds significance to the research, as it reflects the real-world challenges faced by educators and students globally. It focuses specifically on nursing education, which has unique requirements involving both theoretical knowledge and practical skills. This specificity adds depth to the research, allowing for insights tailored to the needs of nursing students and educators.

5. Limitation

First, the study's focus on a single traditional Chinese medicine university and its School of Nursing limits the generalizability of the findings. The results may not be representative of other institutions or nursing programs with different characteristics, such as those in different cultural or educational contexts. Second, the study relies on self-report measures. Self-reported data are subject to biases such as social desirability and response inconsistency, potentially affecting the accuracy and reliability of the findings. Finally, while the study identifies a strong positive correlation between distance education readiness and depth of learning, it may lack depth in the analysis of influencing factors or mechanisms underlying this relationship. Further exploration of mediating or moderating variables could provide a richer understanding of the dynamics at play in distance education among nursing students.

6. Conclusion

In conclusion, DE has provided a new pedagogical approach during the pandemic. This study demonstrates the readiness, and depth of learning of undergraduate nursing students in DE and finds grades could be an influencing factor in DE readiness and depth of learning. The most important discovery is the strong positive correlation between readiness and learning depth, which can guide university teachers to help students better prepare for DE and have better academic performance. Therefore, in the practice of teaching, educational institutions and teachers also need to pay attention to the concept of readiness and develop relevant policies and measures to form a mature distance education process and mechanism.

Data availability statement

The data that support the findings of this study are available on request from the corresponding author.

CRediT authorship contribution statement

Yi Duan: Conceptualization, Formal analysis, Investigation, Methodology, Software, Visualization, Writing – original draft, Writing – review & editing. **Fen Zhou:** Conceptualization, Formal analysis, Methodology, Supervision, Writing – review & editing. **Xiaoyu Li:** Data curation, Formal analysis, Methodology, Supervision, Writing – review & editing. **Liangrong Geng:** Methodology, Software, Writing – original draft, Writing – review & editing. **Shujin Yue:** Conceptualization, Methodology, Supervision, Writing – review & editing.

Declaration of competing interest

The authors declared no potential conflicts of interest with respect to the research, authorship, and publication of this article.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.heliyon.2024.e30602>.

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