

Research on Influencing Factors and Improving Strategies of Online Learning Ability of Chinese Medical Undergraduates

Xue Li¹, Suting Li^{1,*}, Guoming Su¹, Lili Qiu¹, Xiaolong Wang²

¹Health College, Binzhou Polytechnic, Binzhou 256603, Shandong, China

²Ocean College, Binzhou Polytechnic, Binzhou 256603, Shandong, China

* Corresponding author

Abstract

Online learning ability is important in determining the effectiveness of online learning. In this paper, in-depth interview and social network analysis were used to study the relevant factors and their specific relationships affecting the online learning ability of medical students from four medical colleges in different regions of China: the east, south, west, and north. The findings indicate that the main factors affecting the online learning ability of Chinese medical undergraduates are learning motivation, independent learning ability, interactive ability and learning summary ability. Among these, learning motivation is the most important factor. It exerts the greatest impact on interaction ability, and there is a high correlation between them. The influence of learning summary ability on online learning ability is weaker than the other three factors. Based on these results, it is suggested to pay attention to learners' ontological characteristics, enhance learning motivation, innovate classroom interaction design, improve learning interaction ability, clarify teaching methods, improve independent learning ability, improve teaching support and service, as well as promote the ability to summarize and reflect on learning.

Keywords

Medical undergraduates; Online learning ability; Influencing factors.

1. Introduction

With the advent of the "Internet +" era, learning methods of the new generation of learners are also changing. Key to break through the traditional education model and build a new education ecosystem, online courses have become an essential driving force in triggering the reform and development of higher education. Especially during the COVID-19 epidemic, their significant advantages have become even more prominent. Government departments, education authorities and universities have encouraged online teaching in various forms, effectively supporting the effective operation of teaching work. This shift has transformed both teaching methods and student learning styles. In addition, it came with a profound impact on the future teaching mode. In the context of "new medicine", online learning is not only to support the personalized learning needs of medical students in the new era, but also an important backbone of promoting the development of China's medical career and medical talent training. However, due to the diversity of learning groups, the richness of resources, the openness of learning methods and the characteristics of quasi-spatial and temporal separation, the situation of online learning can be complicated and changeable. Learners often experience negative emotions such as anxiety, loneliness and helplessness, which result in high dropout rates and poor learning outcomes [1]. Online learning ability refers to the ability developed by distance learners during their online education, which affects their learning effect, efficiency and individual development [2]. Taking learners as the centre, paying attention to their online

learning experience, improving their online learning ability, and cultivating them into self-driven learners are conducive to improving the quality of online learning and promoting their sustainable learning.

At present, research on medical students' online learning ability mostly adopts methods such as questionnaire survey and theoretical analysis, focusing on the cultivation of learners' single learning ability, aiming at the outcome level of learners' learning [3]. Notably, there is little analysis of learners' actual experiences and cognitive attitudes during the online learning process. In this study, the research group adopted the method of combining in-depth interview and social network analysis, and based on the online learning experience of Chinese medical college undergraduates, delving into the current situation and influencing factors of online learning ability, with a view to promoting the cultivation of online learning ability of medical students and improving the quality of online teaching.

2. Methods Participants

Table 1. Basic information of the interviewees for exploring the influencing factors of medical students' online learning ability [Example (%)].

Category	entry	student
Sex	Male	21 (58.3)
	Female	15 (41.7)
Grade	Year 1	3 (8.3)
	Year 2	8 (22.2)
	Year 3	12 (33.3)
	Year 4	8 (22.2)
	Year 5	5 (13.9)
Major	Five-year Clinical Medicine	8 (22.2)
	Eight-year Clinical Medicine	6 (16.7)
	Public Health Management	3 (8.3)
	Applied Psychology	3 (8.3)
	Nursing	5 (13.9)
	Dentistry	3 (8.3)
	Preclinical Medicine	3 (8.3)
	Preventive Medicine	2 (5.6)
	Biomedical Engineering	3 (8.3)
Number of Completed Online Medical Courses	3 courses	8 (22.2)
	4 courses	11(30.6)
	5 or more courses	17(47.2)

This study adopted the method of "convenience sampling", and collected interview subjects from four medical colleges in different regions of China: Naval Medical University, Southern Medical University, Army Military Medical University and Shandong First Medical University. Interviewees were recruited through acquaintance referrals and online community postings. The inclusion criteria were determined according to the purpose of this study, and the interview subjects meeting the criteria were selected. The inclusion criteria of interviewees: a). have completed 3 or more medical online courses; b); have normal thinking and language skills.; and c). showed high enthusiasm for participating in the study. In addition, in terms of homogeneity, the interviewees were all medical undergraduates, while regarding heterogeneity, the interviewees' professional coverage was widely considered. The sample size was determined by the theoretical saturation principle. The principle of theoretical saturation means that when the information obtained in the interview starts to repeat and data collection

fails to produce new concepts or theories, theoretical saturation has been reached, and sampling should be stopped at this time [4]. Finally, 36 interviewees from the four medical colleges were selected for the study.

3. Research Design

In-depth interviews were conducted between September 2022 and January 2023. These interviews included face-to-face interviews and video interviews, covering the basic information of the interviewees, interview outline, informed consent, etc. Each interview lasted between 30 to 39 minutes. During the interview, the interviewees were first allowed to freely express their online learning experience, after which the interviewer followed the outline to explore the main factors affecting their online learning ability.

After the in-depth interview, a questionnaire survey was given to 38 interviewees about the key events affecting e-learning ability, which would affect the participants' behaviour in a positive or negative manner. This method could direct the analysis to the potential key intervention elements described by the participants themselves, helping to focus and limit the description of changes in the text corpus. The questionnaire was compiled with reference to Chen Meifen's Key Event Technology Evaluation Scale [5], which primarily covers description and analysis of positive and negative events in the online learning process (see Table 2 for details). Through collecting and sorting out these key events in the online learning process of participants, the assessment of influencing factors of online learning ability was modified and improved. This process provided richer research data from different use stages and situations, and it stood as an effective supplement to in-depth personal interviews.

The data from interviews and key events were analysed using Social Network Analysis, which mainly studies the internal composition and organization of various things or phenomena from the perspective of "relationship", so as to obtain the structure and relationship of all elements in the system. The specific steps included concept coding, concept co-occurrence matrix construction, co-occurrence subgroups, degree centrality analysis.

Table 2. Key event statements on influencing factors of medical students online learning ability.

Item	ID	Concept	Key Event Statement
Satisfied	T1	Teaching Methods	The teacher used both live and recorded lessons during online learning, which made interaction efficient and improved the overall learning experience.
	T2	Reinforcing Learning	If I missed or didn't understand something during the live session, I could review the material through the recorded lessons to reinforce my learning.
	T3	Collaborative Learning	A classmate recommended a basic medical course in the discussion area. After joining, I found it very helpful, and I could also participate in discussions in the forum.
	T4	Learning Certification	After completing an online course, I received a certificate, which was valuable for school recognition and greatly increased my motivation to learn.
Dissatisfied	F5	Focus on Learning	While learning online, the platform had many unrelated pop-up advertisements and the course categories were disorganized, which disrupted my focus.
	F6	Learning Discipline	I signed up for several courses and made study plans, but due to time conflicts and being busy, I did not manage to finish many of them.
	F7	Digital Literacy	Sometimes I wasn't familiar with the platform's features, which slowed my progress. I would appreciate a support app to help with platform navigation.

4. Data Analysis

After obtaining the consent of the interviewees in advance, the whole interview was recorded. After the interview, the interview was transcribed word for word to accurately restore the original words of the interviewees. Besides, a random number table method was used to select any row from all labelled interview data, and 2/3 of the data was extracted from left to right. Nvivo11 software was used for open coding. In the coding input process, any self-contradictory

keywords or ambiguous meanings were removed, and 630 original sentences and corresponding initial concepts were obtained. Concepts with similar or identical meanings were combined, and the 7 supplementary concepts extracted from the Key Events Questionnaire Survey on Influencing Factors of Online Learning Power are specifically shown in Table 2. In order to determine whether all concepts had been identified, the remaining 1/3 of the research data was used for theoretical saturation test according to the previous open coding method, which was used as a judgment standard for when to stop sampling. Specifically, it refers to the moment when the analyst cannot further develop the characteristics of a conceptual category. The results indicated that no new concepts have been found to satisfy the theoretical saturation principle, as shown in Table 3. Finally, a total of 32 concepts and main related statements are sorted out, which reflected the meaning of different themes.

Table 3. Influencing factors and statements of online learning ability of medical students.

No.	Concept	Main Statement Items
1	Motivation Level	I feel motivated to learn when taking online courses.
2	Personal Development	I know what I need from online learning—improving my knowledge and clinical skills.
3	Ability to Build Knowledge System	When learning online, I link new information to what I already know to better remember it and use it in practice.
4	Learning Certification	Getting a certificate after finishing an online course boosts my motivation, especially when it helps with school recognition.
5	Focus on Learning	Pop-up advertisements and disorganized course categories on the platform distract me during online learning.
6	Collaboration Ability	When working on team tasks, I ask for help or collaborate with others to get things done.
7	Information Literacy	Sometimes I struggle with using the platform, which slows down my learning. I wish there were an app to help with this.
8	Social Interaction	Online learning helps me meet new peers and make friends.
9	Employment Needs	My motivation depends on whether schools and employers recognize online learning experiences.
10	Broadening Horizons	Online learning broadens my perspective and helps improve my clinical skills.
11	Self-improvement	I learn online to better myself so I can help others and become a competent doctor.
12	Collaborative Learning	A classmate recommended a basic medical course in the discussion area. After joining, I found it very helpful, and I could also participate in discussions in the forum.
13	Reflection	When others share their opinions, I reflect on their insights and what I can learn from them.
14	Interest in Courses	I enjoy learning courses that interest me and believe I'll benefit from them.
15	Sense of Achievement	I want to dive deeper into topics that interest me, and the clear knowledge points in online courses help me improve quickly, which feels quite rewarding.
16	Time Management	During online learning, I know when to take breaks and adjust my study plan as needed.
17	Active Learning	When I face difficulties in online learning, I ask others for advice and learn from their methods.
18	Ubiquitous Learning	I use my free time to study whenever and wherever I can.
19	Self-discipline in Learning	I'm self-disciplined and follow my study plan.
20	Mental State	I stay in a good mental state throughout my online learning sessions.
21	Listening	When a classmate shows me how to learn or solve a problem, I pay close attention.
22	Questioning	When I have questions during online courses, I reach out to the teacher for help.
23	Self-awareness	I try to minimize distractions while studying online.
24	Reinforcing Learning	If I miss or don't understand something during a live class, I use the recorded lessons to review and catch up.
25	Teaching Methods	The teacher used both live and recorded lessons during online learning, which made interaction efficient and improved the overall learning experience.
26	Learning Reflection	After finishing a course, I reflect on how I can improve my learning approach.
27	Active Participation During online learning, I actively	I actively participate during online learning, which makes the environment more engaging.
28	Application of Knowledge	I apply what I learn to clinical practice.
29	Reasoning Ability	During online learning, I connect what I've learned with real-world clinical scenarios.
30	Practical Ability	When I run into issues during online learning, I try to solve them in a timely manner.
31	Feedback and Evaluation	Building upon feedback from the platform or teacher, I attempt to reflect and improve my study methods.
32	Cognitive Ability	During online learning, I understand how to organize the knowledge I've acquired and link it with clinical applications.

The relationship between concepts is the basis of the SNA method. Therefore, this study takes the relationship between concepts in the interview as the research basis. After data processing, a 32*32 co-occurrence matrix based on the co-occurrence relationship between concepts is created (limited to the space presentation part).

Table 4. Concept co-occurrence matrix.

Concept	Motivation Level	Personal Development	Ability to Build Knowledge	Learning Certification	Focus on Learning	Collaboration Ability	Information Literacy	Social Interaction	Employment Needs	Broadening Horizons
Motivation Level	7	7	2	3	1	1	0	4	6	2
Personal Development	7	11	4	5	5	6	6	8	9	6
Ability to Build Knowledge System	2	4	7	4	3	2	5	3	6	3
Learning Certification	3	5	4	10	6	4	2	5	6	5
Focus on Learning	1	5	3	6	8	3	5	7	8	5
Collaboration Ability	1	6	2	4	3	9	4	6	5	7
Information Literacy	0	6	5	2	5	4	10	6	6	8
Social Interaction	4	8	3	5	7	6	6	14	5	7
Employment Needs	6	9	6	6	8	5	6	5	12	5
Broadening Horizons	2	6	3	5	5	7	8	7	5	7

5. Results

Conceptual network relationship of influencing factors of online learning ability. The NetDraw plug-in in SNA software Ucinet 6.204 was used to visualize the relationships between concepts from the co-occurrence matrix. Each node represents a concept, and the connections between nodes represent the co-occurrence relationship between concepts. The conceptual network relationship is illustrated in Figure 1.

Influencing factors of online learning power based on cohesive subgroups. Coachability subgroup refers to the highly cohesive "substructure" existing in the network relationship. The coachability subgroup analysis method can simplify the complex network relationship, which helps researchers identify hierarchical relationships and subgroup structures, and visually display the network structure. In Ucinet 6.204, Convergent Correlation (iterative correlation convergence) algorithm is used to analyse the concepts included in each subgroup, as follows: Subgroup I includes 2, 8, 1, 9, 4, 10, 14, 11, 15; Subgroup II includes 13, 12, 17, 21, 12, 27, 25; Subgroup III includes 6, 3, 5, 7, 16, 20, 19, 23, 32, 29, 30; Subgroup IV includes 31, 28, 24, 18, 26. At the same time, the density between each subgroup is normalized and the subgroup density matrix is obtained. A higher density value indicates a stronger influence of the subgroup and a higher degree of correlation with other subgroups. Subgroup I has a maximum density of 0.788,

which indicates that this subgroup has the highest degree of correlation with other subgroups in the overall conceptual relationship. Further analysis of the correlation coefficients between this subgroup and other subgroups demonstrates that the density of subgroup I and subgroup III stands at 0.743, and the density of subgroup II and subgroup IV is relatively low, which is 0.496 and 0.336, respectively. However, subgroup I remains central within the whole network and plays a role in associating other subgroups.

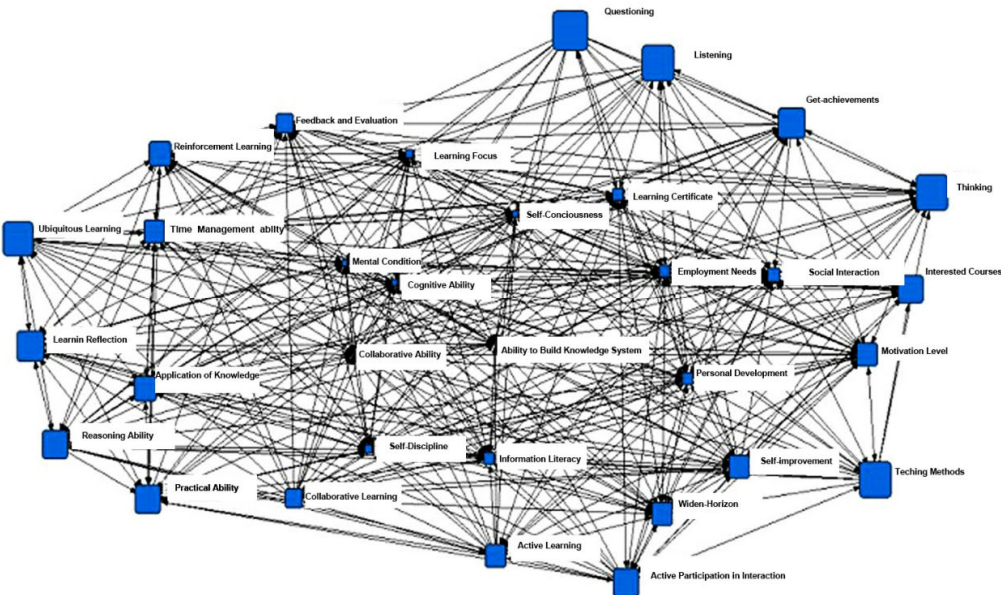


Figure 1. Conceptual network relationship of factors affecting online learning ability of medical students.

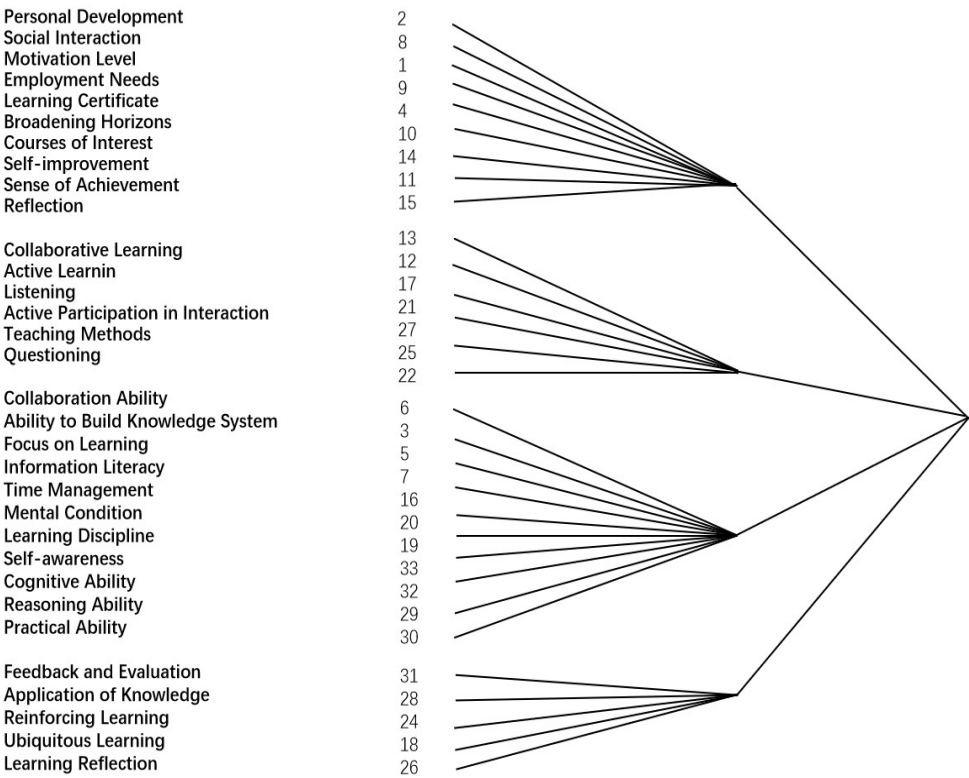


Figure 2. Subgroup division of influencing factors of online learning ability of medical students.

Degree centrality analysis of influencing factors of online learning ability. Using the Convergent Correlation (CONCER) method in Ucinet 6.204, the concepts with high centrality values of each subgroup and the content reflected are calculated. Furthermore, the core elements reflected by the subgroup are extracted by combining the four dimensions of the online learning ability theoretical model. The results show that, as for the online learning experience of medical students, the main factors affecting their online learning ability are learning motivation, autonomous learning ability, interactive ability and learning reflection. Most of the concepts in subgroup I mainly reflect the content related to learners' learning motivation and the elements of internal driving force. Subgroup II primarily concerns the learner's autonomous learning ability in the process of online learning, while reflecting the learning process support. When it comes to subgroup III, it mainly reflects the learner's interactive ability and the reciprocity of learning relationship. In subgroup IV, it focuses on the content related to learning summary and the transformation of learning summary. The concepts of higher centrality in each subgroup are listed in Table 5.

Table 5. Concepts with the top 5 centrality values of the 4 subgroups of influencing factors of medical students' online learning ability.

Concept	Centrality	Concept	Centrality
Subgroup 1 Learning Motivation	Personal Development 41.863	Collaboration Ability 32.653	
	interpersonal communication 40.686	Ability to Build Knowledge System 24.324	
	Motivation Level 32.632	Focus on Learning Information Literacy 18.993	
	Employment Needs 28.437	Time Management 16.543	
	Learning Certificate 25.333	Feedback and Evaluation 24.331	
Subgroup 3 Interactive Ability	Reflection 26.432	Application of Knowledge Reinforcing Learning 23.903	
	Collaborative Learning 23.654	Ubiquitous Learning 22.432	
	Active Learning 23.003	Learning Reflection 16.222	
	Listening 22.543		
Subgroup 2 Self-learning Ability	Active Participation in Interaction 22.065		

6. Discussion

Focus on the characteristic factors of learners' ontology to enhance learning motivation.

According to the above investigation and research, learning motivation holds a central role among all influencing factors and directly affects other factors, which suggests that motivation is one of the most influential factors in medical students' online learning. This aligns with the "synthesis theory" established by Kirby of Harvard University in the United States, which includes factors such as learning motivation [8]. Meanwhile, Li Baomin and Zhu Zhiting also regard learning motivation as an important influencing factor in the study of online learning ability assessment [9]. Similarly, Shi Xue also believes that motivation factors stand as the core factors that drive online learning behaviours and affect online learning ability. Based on the "motivation-behaviour" theory, an evaluation model of online learning ability of college students in blended learning has been established [10]. In particular, personal development, interpersonal communication, motivation level, employment needs, learning certification and other motivation factors are key factors that influence online learning ability. Therefore,

teachers and online course construction teams can make full use of big data mining, so as to conduct portrait analysis of learners and understand the ontology characteristics of learners' cognitive development level, learning ability and learning needs. For example, with the help of big data mining technology and the data recording function of the course platform, educators or researchers can better collect and analyse the teaching information of the course, while comprehensively tracking and grasping the personality characteristics of each student. It is also advisable to carry out portrait analysis for the purpose of understanding the online learning behaviour and learning effect of learners, providing feedback information in time. Returning visit and reminding students who are slow in progress or may abandon school are also essential. It is imperative to analyse learners' existing cognitive development level and learning ability basis, educators and researchers can better master students' learning interests and habits, further exploring proper methods that may stimulate students' interest in learning and meet students' learning needs. Besides, the participants of this study also expressed that "whether the online learning experience can be recognized by the school and the talent market will affect their enthusiasm for online learning". As such, the course construction team should promote the recognition of the value of online learning in an proactive manner and work on innovating the certification, credit recognition, and credit management systems for online courses. Efforts should also be made to share high-quality medical online course resources, especially the mutual recognition of online open and shared courses between universities on the basis of cooperation, win-win and agreement. If the initial credits of the course can be set by the university that recommends the course, other universities can recognize those credits based on their own standards and agreements, so as to improve the value and universality of online course learning and enhance the online learning motivation of medical students.

Innovative classroom interaction design to enhance learning interaction ability. The density of interactive ability subgroup is second only to the learning motivation ontology characteristics subgroup, and its influence on the online learning ability of medical students remains in a relatively important position, showcasing a close connection with the learning motivation subgroup. This is also in line with the work of Guy Claxton of the University of Bristol in creating the Effective Lifelong Learning Inventory, In the "Four-element theory" on learning force proposed by ELLI, reciprocal/Relationships [11] refers to the ability to learn independently and cooperatively while sharing learning results. Most interviewees expressed that they hope teachers can innovate classroom interaction design and fully mobilize the enthusiasm of learners to participate in classroom interaction.

During this process, information technology can be adopted to cleverly integrate expanded content, exercises, and thought-provoking questions into online teaching. Students can use their mobile phones to scan a QR code for online learning, self-test, reading and reflection. Teachers can provide feedback on students' learning progress through mobile apps for evaluation and analysis. This approach is conducive to achieving the interactive integration of online and offline, students and teachers. It is also helpful for learners to engage in cooperative learning and active learning through "fragmented time". Furthermore, students can give feedback on the difficult and unclear problems they encounter through the discussion forums of the online course platform, the Wiki collaborative creation system, QQ, MSN, WeChat, Weibo and other interactive ways. In this context, teachers can grasp the learning effect of students in real time, and publish online live topics accordingly. In the interactive discussion of students, teachers or teaching assistants should provide "learning support" in a timely manner to guide learners to conduct more in-depth exploration of a certain topic (or question) around the content taught in the live class. By doing so, they can enhance the depth and breadth of interactive learning.

Effective teaching strategies for better independent learning ability. There is a high correlation between self-learning ability subgroup and learning summary ability, which

indicates that the influencing factors of these subgroups are closely related to each other to some extent. Through the investigation, it is also found that medical students' self-learning ability targets the interaction and cooperation ability in online teaching design, the ability to construct knowledge systems, and their concentration while learning. The elements of self-learning ability in this study have similar meanings to the six elements of learning ability summarized by Yu Jianxiang, such as learning methods, time management, learning will and learning habits [12]. These are grouped under independent learning ability in this research. It is also similar to the ability to comprehensively apply corresponding strategies or methods according to learning needs in order to achieve learning goals and cope with learning interference in the online learning process emphasized by Zhao Lei's research group as an element of online learning ability [13]. Meanwhile, interviewees believe that appropriate online teaching methods are conducive to the construction of their knowledge system, the training of interaction and cooperation ability, and the improvement of online learning concentration and time allocation management, as well as other abilities. This indicates that online teaching should incorporate flexible methods such as Case-based learning (CBL) and Problem-based learning according to learners' information literacy, course teaching content and students' learning characteristics. On the other hand, group discussion, role play, inspired guidance, task-driven and other flexible teaching methods are also of significance to the aim of highlighting the teaching characteristics and guiding students to think positively. Under such circumstance, students' interaction, collaboration ability and focus on online learning can witness great progress. During teaching implementation, academic debates can be incorporated as a reference point to spark student curiosity and help them construct their own knowledge system in an effective manner. In dealing with key problems, multiple teaching methods such as real cases, model charts and tables can also be used to deepen the student's understanding in multiple dimensions [14]. In terms of the processing of difficult problems, summarizing the disposal process in the form of charts or making small videos with important and difficult points in the form of two-dimensional code acquisition are optimal choices.

Improve teaching support and services to improve the ability to summarize and reflect.

Summary reflection ability subgroup comes with the smallest density, which indicates that it has less impact on online learning ability compared to the other three factors. Among this subgroup, the more influential factors are evaluation feedback, application of knowledge, reinforce learning, ubiquitous learning, and learning summary. Some interviewees mentioned that the online course construction team has not formed a mature and operational online teaching incentive mechanism or a reliable support team for online teaching.

Therefore, the online course construction team should facilitate the feedback channels between teachers, learners and platform managers. It is important to pay attention to learners' demand feedback for teacher-student interaction in the teaching process, realizing timely communication between teachers and learners and answering students' questions in the discussion area. These efforts help understand learning difficulties and needs [15]. Learners' feedback on the learning experience of medical online courses should be emphasized and included in the evaluation of the quality of online course construction, giving teachers the necessary insight to adjust course structures. In addition, it is necessary to build a smooth and proper feedback channel between platform managers and learners. Specifically, this could include regular questionnaire survey on users' learning status, real-time recording of students' learning process and results through background data recording and analysis function, feedback on students' current learning status, and offering learning alerts, learning reminder and other services. These services and data form the foundation of targeted support for improving the ability of medical students to summarize and reflect on their learning experiences.

7. Limitations

The main limitation of this study resides in the fact that the online learning ability of medical students is dynamic and procedural, which will be affected by many aspects, and the survey results are variable. If long-term follow-up research and regular interview can be conducted for learners, the survey data can be more accurate. Another limitation of this study is that due to the limitations of objective conditions, the sample size of the subjects is not enough, only to understand the basic situation of online learning in a short period of time and within a limited scope. Large-scale surveys involving many medical schools and online learning data are needed.

Acknowledgments

We are grateful to all of the students and staff who helped us with our research.

Conflict of Interest

All authors declare that there is no conflict of interest

Author Contribution Statement

Xue Li: data collection, paper writing; Guoqiong Huang: paper guidance and revision; Xiaolong Wang: paper writing; Lili Qiu: data collection; Xiaoxue Wang: data collection; Suting Li: data collection.

References

- [1] Zhang Jingxin, Jiang Qiang, Zhao Wei. Research on Influencing factors of social presence in online learning and academic early warning based on the perspective of C-OL Theory [J]. Current generation distance Education, 2019 (4) : 38-47. DOI:10.13927/j.cnki.yuan.2019.0038.
- [2] Zheng Q H, Xu Y Y. E-learning power: Structural characteristics and influencing factors [J]. Open Education Research, 2019,26(4) :77-85. DOI:10.13966/j.cnki.kfjyyj.2020.04.009.
- [3] Li Baomin, Gong Lingling, Zhu Zhiting. Development and verification of Online Learning ability assessment tool [J]. Research on Open Education, 2018, 24(3) :77-84,120.
- [4] Li Yanping, Guo Wei, Huang Xia. Characteristics of effective use of scientific research funds and its influencing factors: Based on grounded theory [J] Scientific Research, 2009, 27 (11): 1685-1691.DOI:10.16192/j.cnki.1003-2053.2009.11.026.
- [5] Chen Meifen. Research on the relationship between User experience and Learning motivation of massive online courses [D]. Wuhan: Central China Normal University, 2017.
- [6] Li Jin, Zhang Ning, Yun Xiao. Deep Construction of engineering students' autonomous learning Ability under the Background of New engineering: A case study of "Modern Cryptography" SP0C Flipped classroom in X University [J]. Higher Engineering Education Research, 2018(5) :71-77.
- [7] Liu Jun. Introduction to Social Network Analysis [M]. Beijing: Social Sciences Academic Press, 2004:115-117.
- [8] Kirby. Learning Power [M]. Golden Grain, trans. Haikou: Southern Press, 2005: 6-15.
- [9] Li Baomin, Zhu Zhiting. From "learning" focusing on the result to "learning" focusing on the process: A study on the evaluation and development strategies of online learning ability of network scholars [J]. Open Education Research,2017, 23(4): 92-100.DOI:10.13966/j.cnki.kfjyyj.2017.04.009.

- [10] Shi Xue. Research on Evaluation and Improvement of College students' Online Learning Ability in Blended learning [D]. Jinan: Shandong Normal University, 2020.
- [11] CLAXTON G. Building learning power: Helping young people become better learners[M]. Bristol: TLO, 2002.
- [12] Yu Jianxiang. The ultimate learning password [EB/OL]. [2022-10-13].
- [13] ZHAO Lei, Tian Dan, Zhang Ding. College students' online learning ability evaluation scale development research [J]. China medical education technology, 2024, 38 (03) : 303-310 + 318.
- [14] Amir L, Tanti I, Maharani D A, et al. Student Perspective of Classroom and Distance Learning During COVID-19 Pandemic in the Undergraduate Dental Study Program Universitas Indonesia[J]. BMC Medical Education, 2020, 20(1):392. DOI:10.21203/rs.3.rs-42334/v2.
- [15] Asfani, K., Suswanto, H., & Wibawa, A. P. (2016). Influential factors of students' competence. World Transactions on Engineering and Technology Education, 14(3), 416-420.