

Influence Study of Learners' Independent Learning Ability on Learning Performance in Online Learning

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Abstract—In this paper, questionnaires regarding the influence of learners' autonomous learning ability on learning performance in online learning were designed, and the mediating role played by deep learning orientation in the effect of autonomous learning ability on learning performance was analyzed. The results revealed that the overall Cronbach's α coefficient of the questionnaire was 0.884, the KMO value was 0.817, and the corresponding P value was 0.000, manifesting the good reliability and validity of this questionnaire. The learning performance could be obviously influenced by four aspects of autonomous learning ability: preparation of technology and target plan, utilization of materials in learning contents, regulation of learning process, and evaluation of learning effect. Deep learning orientation played a complete mediating role in the promoting effect of autonomous learning ability on learning performance. Learning frequency exerted a significant (0.01) influence on learning performance. Results are of considerable importance to enriching the literature on online learning environments and the development of autonomous learning ability, helping learners to cultivate autonomous learning ability, and enhancing the effectiveness of guidance provided by teachers to learners in online learning environments.

Keywords—online learning, autonomous learning ability, evaluation of learning effect, learning performance

1 Introduction

With the development era and continuous scientific and technological progress, the educational reform triggered by the development of network technology is now more extensive and profound. The continuous revolution of educational ideas, approaches, and forms is therefore facilitated. Online teaching platforms have boosted the innovation and change of traditional teaching models so that more learners are more autonomous. As technologies like the internet develop rapidly in contemporary society, the approaches and methods adopted by learners to acquire knowledge become more diversified, enabling the teaching process to break through the traditional temporal-spatial physical limits and endowing learners' learning motivation and learning style with higher flexibility. Online learning is a relatively new mode of resource sharing

and education and teaching, and it has been widely accepted and participated in by students and social learning groups due to its various advantages like learning convenience, autonomy, and diversified teaching resources. The development of the modern internet mainly featured by big data, cloud computing, and artificial intelligence has increasingly provided students' autonomous learning with a personalized technological base at a high communication rate.

Autonomous learning is a good learning style that can facilitate learners to master knowledge systems and comprehensively transform knowledge into their inherent knowledge. A good autonomous learning ability, to a great extent, is very conducive to improving students' learning performance. However, influenced by traditional and examination-oriented teaching, the traditional teaching model values teachers more than students. The emerging online teaching model shifts the emphasis from traditional classroom-based teaching onto learning. The model puts learning at an equal status to teaching, meaning that higher education keeps up with the development of the times and continuously matures. Online learning is an educational form more suitable for ability development and acquisition. With continuous technological development, online learning will not just be concerned the curriculum itself but will pay more attention to the improvement of learning groups' autonomous learning ability. Thus, learners' learning performance is comprehensively improved. The research on the development of students' autonomous learning ability in the online learning environment can enrich the theories related to teaching and learning in the new era so that the online learning environment constructed can truly realize learner-centered teaching and conform to the new concept of teaching and learning in the new era. The environment can enrich and develop theories associated with students' autonomous learning. Only when students have powerful autonomous learning abilities can they adapt better to contemporary social development and continuously regulate and perfect their own autonomous learning beliefs.

2 Theoretical basis

Autonomous learning is one of the important research contents of educational psychology. The autonomous learning theory proposed by Zimmerman B. J [1] is globally recognized. Explaining this phenomenon, Zimmerman indicated that the learning autonomy of students depended on whether they behaved as active participants in three aspects: meta-cognition, motivation, and behavior. The three aspects are characterized by three types of factors. Personal factors include self-knowledge, self-efficacy, and learning objective. Behavioral factors include self-judgment, self-observation, and self-reaction. Environmental factors include social environment and physical environment. This theory laid a good foundation for the subsequent research on self-learning. Subsequently, Crome, K et al.[2] introduced autonomous learning in detail. He thought that as to autonomous learning ability, learners started reflecting upon autonomous learning, namely, independent thinking ability was an acquired habit. McCombs, B. L et al. [3] deemed that learners should utilize the processes required by autonomous learning and generate positive influences and motivations on

and for learning tasks and required spiritual efforts. Then, he described a causal model based on these relationships. Ponton, M. K et al. [4] thought that the autonomous learning theory was consistent with Bandura's social cognitive theory and provided heuristic guidance for future research on adults' learning. Factors like self-efficacy, cognitive motivation, and sense of identity were mainly included in the autonomous learning theory. Masouleh, N. S et al. [5] pointed out that the autonomous learning ability was not inborn but must be imparted, so guidance from teachers was needed. When learners enter a learning situation, teachers must possess the knowledge and skills of planning, monitoring, and evaluating students' learning. Hence, the literature shows that autonomous learning is a system with the interaction of ego, behavior, and environment. In such a system, individuals interact with behaviors. Personal intrinsic factors can be self-fed back and regulated. Environment influences individuals, and behaviors influence the environment. During the autonomous learning process, autonomous learners can feed back and regulate among self-cognition, emotion, and own behaviors. The external environment also has a bearing on ego, so learners continuously change their autonomous behaviors to better improve their autonomous learning ability due to the effects of the external environment.

3 Research design

3.1 Research hypotheses

The problems related to autonomous learning ability have always been a focus among scholars in the field of education. How autonomous learning ability influences learning performance has been extensively investigated at both home (China) and abroad. Guo, H [6] deemed that autonomous learning ability could effectively improve learners' language acquisition strategies. Torres, W. J et al. [7] used age and non-ability characteristics as the factors deciding autonomous learning activities and tested a model on massive open online sources (MOOC), and the results showed that autonomous learning activities could evidently enhance learners' enthusiasm for learning on MOOC and improve their learning performance. Thanasoulas, D [8] thought that learners' autonomous learning ability could radically change the excessive environmental reliance of learners. Du, Y [9] considered that college students' autonomous English learning motivation could be greatly enhanced by cultivating and strengthening autonomous learning ability. Li, Y et al. [10] found that peer review and self-evaluation, which served as tools, were effective in changing students' learning styles. Through an investigation on 60 students in Lanzhou University of China, Li concluded that learning performance could be effectively improved by autonomous learning ability. Siriwongs, P [11] believed that learners could determine their personal learning style and reach their own learning needs by enhancing their autonomous learning ability. Tousignant, M et al. [12] used a self-evaluation questionnaire to measure the self-evaluation ability of 70 junior students in a four-year program under two different circumstances. The results indicated that when performing after-action self-evaluation, students could enhance their learning motivation. Garrison, D. R [13]

held that autonomous learning comprised three dimensions: self-management, self-monitoring, and learning motivation. Chou, P. N et al. [14] analyzed whether autonomous learning was a key factor influencing learning performance, carried out deep analysis and discussion through case studies, and found that autonomous learning influenced learning performance under network environment differently among the six cases. Rashid, T et al. [15] deemed that student participation and self-orientation were associated with schoolwork. Their results showed that students' technology use had complicated correlations with the degree of student participation, autonomous learning, and academic achievement. Khiat, H [16] explored the correlation between the perception level of mature students for self-oriented learning and their academic achievement. Their results showed that their perception level for 11 autonomous learning indexes had a direct or indirect bearing on their academic achievement. Artis, A. B et al. [17] concluded that learners' self-orientation and self-oriented learning skills were of considerable importance for promoting sales personnel to utilize self-directed learning methods. Chou, P. N [18] studied the correlation and causal relationship between students' autonomous learning ability and learning. The results in a computer laboratory showed that, in particular, the autonomous learning ability of engineering students was positively correlated with their online learning performance. Zimmerman, B. J [19] thought that autonomous learning ability comprised four aspects: preparation of technology and target plan, utilization of materials in learning contents, regulation of learning process, and evaluation of learning effect. Learning performance will also be affected by learners' learning orientation in the learning process. Therefore, in this paper, deep learning orientation was selected as the mediating variable and the four aspects of autonomous learning ability proposed by Zimmerman, B. J [19] as independent variables. The following five hypotheses were put forward:

H1: In online learning, the preparation of technology and target plan can obviously improve learning performance.

H2: In online learning, the utilization of materials in learning contents can evidently promote learning performance.

H3: In online learning, the regulation of learning process can evidently enhance learning performance.

H4: In online learning, the evaluation of learning effect can significantly promote learning performance.

H5: In online learning, deep learning orientation plays a mediating role in the effect of autonomous learning ability on promoting learning performance.

3.2 Questionnaire design

Based on the existing measurement scales for online learning, autonomous learning ability, and learning performance, a "questionnaire about the influence of learners' autonomous learning ability on their learning performance in online learning" was prepared by combining the actual demands of this paper. The questionnaire comprised 4 aspects, totaling 38 questions. The first part presented the basic information of stu-

dents with 5 questions: gender, grade, major, online learning platform, and online learning frequency.

The second part aimed to measure autonomous learning ability. The four aspects in the research framework proposed by Zimmerman, B. J [19], namely, preparation of technology and target plan (3 questions), utilization of materials in learning contents (3 questions), regulation of learning process (6 questions), and evaluation of learning effect (3 questions), were referenced here.

The third part was the measurement of learning performance using the learning performance questionnaire compiled by Wang, D [20] and widely quoted in China. This questionnaire divided learning performance into three dimensions: quality, behavior, and time, for a total of 15 questions. By comparison, 8 questions were selected to remeasure the learning performance.

The fourth part described the measurement of mediating variable (deep learning orientation), and 10 questions were measured by referring to Biggs, J et al. [21]. For all the questionnaires, scores were counted using a seven-point Likert scale.

3.3 Respondents

Henan Province is a powerful province of higher education in China. In this paper, the school of economics and management in a regular institution of higher learning in Henan Province was taken as the research object. The institution began its online teaching reform in 2018 and encouraged teachers to implement online–offline blended teaching reform. All professional core courses are covered at present. The research group where the author worked implemented an investigation on the students in this school through questionnaires at break time for two weeks in the fall semester, academic year 2020–2021. A total of 251 questionnaires were given out on the spot under the guidance of teachers. All students carefully filled in the questionnaires, and all questionnaires were collected. After invalid questionnaires were excluded, 222 valid ones were acquired, with an effective recovery rate of 88.45%. The concrete descriptive statistical results are listed in Table 1.

As seen in Table 1, women majoring in economics and management accounted for a relatively high proportion. Tencent Classroom became the main online teaching platform. Impacted by COVID-19, more teachers chose the online teaching mode so that the learning frequency of learners per week was mostly kept at 13–19 hours, which accorded with the current situation of undergraduate online teaching in China.

Table 1. Descriptive statistical results of respondents

Name	Item	Frequency	Percentage (%)	Cumulative percentage (%)
Gender	Male	80	36.04	36.04
	Female	142	63.96	100
Major	Economics	26	11.71	11.71
	International Economics and Trade	35	15.77	27.48
	Accounting	83	37.39	64.86
	Human Resource Management	31	13.96	78.83
	Business Administration	33	14.86	93.69
	Marketing	14	6.31	100
Grade	Freshman	34	15.32	15.32
	Sophomore	118	53.15	68.47
	Junior	15	6.76	75.23
	Senior	55	24.77	100
Platform	Other platforms	2	0.9	0.9
	QQ live broadcasting	9	4.05	4.95
	WeChat	43	19.37	24.32
	Tencent Meeting	69	31.08	55.41
	Tencent Classroom	99	44.59	100
Learning frequency	Over 26 hours per week	45	20.27	20.27
	20-25 hours per week	51	22.97	43.24
	13-19 hours per week	68	30.63	73.87
	9-12 hours per week	38	17.12	90.99
	5-8 hours per week	10	4.5	95.5
	1-4 hours per week	10	4.5	100
Total		222	100	100

4 Result analysis

4.1 Reliability and validity test

In general, reliability analysis is required for all scales. First, the questionnaire in each part was subjected to the reliability test using Cronbach's α coefficient via SPSS22.0. If the Cronbach's α coefficient was greater than 0.7, the questionnaire was highly reliable, and a higher Cronbach's α coefficient represented a higher reliability level.

Table 2 shows that the Cronbach's α coefficient of all variables was greater than 0.8, and the overall Cronbach's α coefficient of questionnaires was 0.884, indicating good questionnaire reliability.

The validity test aims to test whether the measurement tool can accurately measure the related trait or the corresponding theoretical concept. Construct validity denotes the degree to which the measurement tool can reflect the internal structure. Specific-

ly, the result obtained by a questionnaire survey is consistent with the theoretically expected result.

Table 2. Reliability test result

Variable	Question No.	Corrected item total correlation (CITC)	Item deleted α coefficient	Cronbach's α coefficient	Cronbach's α coefficient
Preparation of technology and target plan (independent variable-1)	A1	0.604	0.855	0.832	0.884
	A2	0.741	0.72		
	A3	0.736	0.722		
Utilization of materials in learning contents (independent variable-2)	B1	0.68	0.805	0.841	
	B2	0.709	0.778		
	B3	0.731	0.754		
Regulation of learning process (independent variable-3)	C1	0.861	0.842	0.886	
	C2	0.759	0.856		
	C3	0.86	0.843		
	C4	0.82	0.85		
	C5	0.754	0.858		
Evaluation of learning effect (independent variable-4)	C6	0.331	0.94	0.947	
	D1	0.921	0.898		
	D2	0.886	0.926		
Learning performance (dependent variable)	D3	0.864	0.943	0.927	
	Y1	0.743	0.918		
	Y2	0.725	0.919		
	Y3	0.753	0.917		
	Y4	0.777	0.915		
	Y5	0.728	0.919		
	Y6	0.723	0.92		
	Y7	0.78	0.915		
Deep learning orientation (Mediator)	Y8	0.797	0.914	0.856	
	M1	0.381	0.86		
	M2	0.403	0.855		
	M3	0.591	0.84		
	M4	0.546	0.844		
	M5	0.597	0.839		
	M6	0.627	0.836		
	M7	0.582	0.841		
	M8	0.611	0.838		
	M9	0.655	0.835		
M10	0.647	0.836			

Table 3 shows that the KMO value of Bartlett sphericity test of scales in this paper was 0.817, and the corresponding *P* value was 0.000, indicating favorable validity.

Table 3. Validity test result

KMO value		0.817
Bartlett sphericity test	Approximate Chi-square	5904.525
	Df	528
	<i>p</i> value	0.000

Table 4 shows that the AVE value of each variable was greater than the maximum absolute value of correlation coefficient between factors, indicating good discriminant validity.

Table 4. Discriminant validity: Pearson correlation and average variance extracted (AVE)

	Independent variable-1	Independent variable-2	Independent variable-3	Independent variable-4	Dependent variable	Mediator
Independent variable-1	0.796	-	-	-	-	-
Independent variable-2	0.075	0.801	-	-	-	-
Independent variable-3	-0.031	0.058	0.77	-	-	-
Independent variable-4	0.209	0.345	0.193	0.928	-	-
Dependent variable	-0.009	0.101	0.314	0.24	0.785	-
Mediator	0.109	0.236	0.123	0.457	0.169	0.596

Remark: The clinodiagonal blue figure is AVE value.

4.2 Regression analysis

Table 5 shows that the model passed the F test ($F=121.433$, $p=0.000<0.05$). Therefore, the four hypotheses proposed in this paper all held true.

Table 5. Linear regression result

Variable	Standardized coefficient	T	p	VIF	Adjusted R²	F
Constant	-	2.618	0.009**	-	0.686	F (4,217) =121.433, $p=0.000$
Preparation of technology and target plan	0.12	3.074	0.002**	1.07		
Utilization of materials in learning contents	0.1	2.528	0.012*	1.099		
Regulation of learning process	0.776	19.821	0.000**	1.077		
Evaluation of learning effect	0.048	1.244	0.215	1.028		

* $p<0.05$ ** $p<0.01$

H1 held true. The main reason for this result is that if learners have a stronger ability to prepare the technology and target plan in online learning, they can gain the ability to operate the technologies in the online learning environment, activate the original knowledge system according to the corresponding learning situation and learning tasks and formulate their own learning objectives and learning plans. Learners are required to fully understand the curriculum introduction made by teachers, including teaching syllabus, course introduction, teaching objectives, important and difficult points of teaching, course videos, and expanded resources. A good learning resource plan should be made before learning. Different types of learners need to find the learning resource that fits them best and make a good learning plan, which is the precondition for them to enhance their own abilities and improve their learning performance.

H2 held true. Learners need to search and acquire learning contents and materials according to their own needs, distinguish and screen the acquired information, and deeply process such information and truly apply it into their learning process. Faced with various forms like audio, video, text, image, and animation in online learning environments, learners are required to complete interesting learning activities with learning resources by sufficiently and scientifically combining the corresponding learning activity design. Learners can shape their own learning methods with the corresponding resources needed, effectively utilize, and conveniently and rapidly find learning materials within a short time to smoothly complete the corresponding learning tasks.

H3 held true. Learners should strictly execute the prepared learning plans, autonomously manage and adjust their learning time, actively regulate the emotions generated in the learning process, and, if failing, consult with peers and teachers for a proper method. If learning is promoted as per the preset learning plans, learners can generate deep learning motivations, which can promote the gradual development of their autonomous learning ability and finally improve their learning performance. Online learning environments can provide diversified technologies to support the interaction between learners who, therefore, can continuously learn in all forms of cooperation by taking full advantage of richer interactive modes, more interaction opportunities, and a broader interaction space. Learners should also enhance the awareness of interacting with peers, strengthen the advantages and challenges of cooperative online learning, adjust their own learning process, and make efforts to act in line with the preset learning objectives and learning plans, thereby comprehensively enhancing their learning performance.

H4 held true. Learners can test their own learning results and summarize and reflect upon their own advantages and disadvantages on this basis. To improve students' autonomous learning ability, technologies like big data and cloud computing should be efficiently and actively utilized to continuously popularize the online learning form and promote online learning environment construction. As for learning evaluation in online learning environments, learners should be the key link, and the traditional learning method should be continuously reformed. Learner-centeredness can be truly realized if learners pay more attention to process evaluation as well as knowledge exploration and seeking and assiduous learning. This focus inspires colleges and uni-

versities to concern themselves about online learners' interests in learning tasks, cognition of learning contents, and their subjective inference for self-learning, and facilitate them to continuously adjust their own learning strategies and methods. Such efforts will help to enhance learners' interests in online learning and improve their autonomous learning ability.

4.3 Mediating effect

As revealed by Table 6, H5 held true, namely, deep learning orientation plays a complete mediating role in the promoting effect of autonomous learning ability on learning performance. The main reason for this finding is that totally different from the traditional classroom, online learning lacks the regular supervision of teachers, enabling learners to complete autonomous learning in a freer and looser environment. However, in such a loose autonomous learning environment, learners must have strong self-regulation and self-control abilities, along with enough learning motivations. Only thus can suitable learning strategies be selected more accurately. The learners with stronger deep learning orientation are ready to proactively participate in learning activities and more actively adopt suitable learning strategies. Therefore, deep learning orientation exerts a certain effect on associating autonomous learning ability with learning performance. In the construction of online learning environments, more attention should be paid to motivating learners' deep learning orientation to enhance their learning performance.

Table 6. Mediating effect result

	Learning performance	Deep learning orientation	Learning performance
Constant	4.345** (20.161)	4.055** (21.140)	3.614** (9.736)
Autonomous learning ability	0.042 (0.845)	0.156** (3.556)	0.014 (0.269)
Deep learning orientation	-	-	0.180* (2.406)
Sample size	222	222	222
R ²	0.003	0.054	0.029
Adjusted R ²	-0.001	0.05	0.02
F value	F (1,220) =0.714, p=0.399	F (1,220) =12.645, p=0.000	F (2,219) =3.258, p=0.040

* p<0.05 ** p<0.01 In the brackets are t values

4.4 Difference analysis

Table 7 shows that learning frequency influenced learning performance at a significance level of 0.01 (F=3.609, p=0.004), but a higher learning frequency does not always improve the learning performance more. Specifically, learners could achieve higher learning performance under a low learning frequency (1–8 hours per week). The main reason for this result is that the majors of economics and management predominantly belong to knowledge transfer-type majors. Especially for some courses,

teachers particularly emphasize the traditional live broadcasting mode, i.e., the pure lecturing mode, without effective interaction. This practice encourages college teachers to pay more attention to the development of online teaching resources, avoid simple lecturing through live broadcasting, and motivate learners' initiatives by means of group discussion, brainstorming, and grouping assignment to enlarge their learning input. Learners also show high learning performance under a high learning frequency (20–25 hours per week), possibly because in online learning, basic subjects regarding economics and management like Management Science, Macroeconomics, and Microeconomics need the input of long learning time to watch more learning videos. With rich knowledge points and complex structure of these subjects, learners are required to spend more learning time, contributing to their high learning performance. This relationship indicates that more college teachers with high professional titles and rich teaching experience are needed to teach learners, and the assessment criteria should be standardized so that learners majoring in economics and management can learn under the same assessment scale, thereby guaranteeing their learning fairness and promoting their endogenous learning motivation.

Table 7. Difference in the influence of learning frequency on learning performance

	Learning frequency (mean± standard deviation)						F	P
	1.0 (n=45)	2.0 (n=51)	3.0 (n=68)	4.0 (n=38)	5.0 (n=10)	6.0 (n=10)		
Learning performance	3.87±1.47	4.71±1.65	4.68±1.54	4.08±1.46	5.10±1.52	5.50±1.43	3.609	0.004**

* p<0.05 ** p<0.01

5 Conclusion

Owing to the popularization of modern information technology in education, online learning, a characteristic learning pattern, has become a very important path for learners to learn autonomously. In online learning environments, learners' autonomous learning ability can facilitate them to learn autonomously and creatively with positive attitudes to continuously improve their own learning performance. In this study, questionnaires with regard to the influence of learners' autonomous learning ability on learning performance in online learning were designed, and the mediating effect of deep learning orientation on the influence of autonomous learning ability on learning performance was analyzed. The results show that the questionnaires designed in this paper are of good reliability and validity. All four aspects of autonomous learning ability can obviously influence learning performance. Deep learning orientation plays a complete mediating role in the promoting effect of autonomous learning ability on learning performance. Learning performance is influenced by learning frequency at a significance level of 0.01. Deep research is suggested to be carried out regarding the influence factors of autonomous learning ability in the online learning environment by combining the influence degrees of different teaching models in online teaching on autonomous learning ability and the relationships of autonomous learning

ability with other variables (e.g., learning input, organizational performance, and positive emotion).

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