Relationship between the on-line learning environment and students' learning self-efficacy

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ABSTRACT: In order to study the relationship between on-line learning environments and students' self-efficacy, an investigation based on 686 valid questionnaires was conducted. By using descriptive analysis, correlation analysis and regression analysis, the results show that five environmental factors have a certain impact on students' learning self-efficacy. These are: 1) learning content organising format; 2) learning content applicability; 3) learning support availability; 4) easy use of learning support; and 5) interactive form of learning. These factors each have a different impact, and they work together to impact on learning self-efficacy.

INTRODUCTION

A self-efficacy concept was first raised by A. Bandura, an American psychologist in the late 1970s. Learning self-efficacy is its reflection in the learning field, which refers to an individual's beliefs in her/his learning ability, self-evaluation of whether he/she is able to accomplish learning tasks by his/her acquired ability and skills, and a subjective judgment about his/her control over his/her study behaviours and performance [1]. A number of studies have shown that an individual's learning self-efficacy has various impacts on his/her learning interests, learning motivation, learning control and performance [2]. However, as a psychological intervening variable, self-efficacy itself has a four main influencing factors: performance accomplishments, vicarious experience, verbal persuasion and physiological states [3].

The rapid development of information technology, centred on computer multimedia technology and network communication technology, and its wide spread and applications in the learning field, inevitably leads to learning environment reform, and it nurtures and forms the *on-line learning environment* [4]. Facing this reform of the learning environment, which the learner often is not used to, he/she may encounter *learning difficulties* that would have an impact on his/her learning quality and efficiency. However, only some studies have been conducted on the relationship between the learning environment and learning self-efficacy. Therefore, this article focuses on relations between an on-line learning environment and learning self-efficacy, and explores environmental factors, which impact on self-efficacy. It has a crucial meaning to optimising the on-line learning environment and improve students' learning self-efficacy.

PURPOSE AND ASSUMPTIONS

College students are the research subjects for this study. It starts from elements of on-line learning environment factors in environment dimensions, investigates in depth environmental factors, which affect student learning self-efficacy to reveal the correlation between learning environment and learning self-efficacy and, thus, to provide a scientific base for on-line learning environment optimal construction and development, and improvement of students' self-efficacy.

The on-line learning environment, based on computer technology and network communication technology, supports students to engage in learning activities in various conditions [5]. There are several studies on factors related to the learning environment, but even though there is a slight difference between each of these, they have three main aspects in common: learning contents, support and social structure [6].

Learning contents is the subject of learning, including designed courses, assignments, activities, etc: learning support refers to all the supports provided to students in the process of learning contents, including design tools, resources, case studies, examples, etc; and the learning social structure refers to all the relational structure among learning elements, including relations between students and teachers, students and students, human-technology and space structure.

Based on the above analysis, the main assumptions for this research are: the on-line learning environment has an impact on college students' learning self-efficacy. From this base, there are three sub-assumptions:

1. Learning contents from the on-line learning environment have an impact on learning self-efficacy of college students.
2. Learning supports from the on-line learning environment have an impact on learning self-efficacy of college students.
3. Learning social structure from the on-line learning environment has an impact on learning self-efficacy of college students.

COMPILATION OF SCALE

Preparation of an Initial Scale

Currently, there are some established self-efficacy scales and learning self-efficacy scales including *General Self-Efficacy Scale*, *CSES* by Schwarzer and Jerusalem [7] *Student Efficacy Scale, MJSES* by *Jinks* and *Morgan* [8]; and S*elf-Report of Learning Self-Efficacy* by Pintrich and De Groot [9]. This study is based on all the above scales, it designs from three dimensions, *learning content, learning supports* and *learning social structure*, respectively, and it forms corresponding *learning content factor scale*, *learning support factor scale* and *learning social structure scale*.

Among them, there are eight questions for the *learning content factor scale*, 10 for the *learning support factor scale* and four for the *learning social structure factor scale*. In each scale table, the authors use a five-point Likert scale, which includes five levels: strongly agree, agree, undecided, disagree and strongly disagree (see Table 1).

Table 1: Investigation table of on-line learning factors impacting on college students learning self-efficacy.

Learning content factor scale						
No	Questions	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
1	In the e-learning environment, I am confident that the content's logic helps to better understand the content.					
2	In the e-learning environment, I am confident that various formats of content help to better understand the content.					
3	In the e-learning environment, easily spread and shared content will improve my learning efficiency.					
4	In the e-learning environment, I can grasp more information quickly for open and updated content.					
5	In the e-learning environment, I believe I can complete the tasks more quickly with various activities.					
6	In the e-learning environment, close and relevant activities design helps me to better understand.					
7	In the e-learning environment, content with moderate difficulty helps raise my confidence to complete the tasks.					
8	In the e-learning environment, various learning activities can meet my needs and I believe I can complete all of them one by one.					
Learning support factor scale						
No.	Questions	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
9	In the e-learning environment, efficient search tools can help me quickly find useful information.					
10	I can often use e-learning tools to resolve the difficulties encountered in the study.					
11	It is very easy for me to use on-line learning tools.					
12	In the e-learning environment, various material sources can better support my study.					
13	In the e-learning environment, easily downloaded material helps me study anytime and increase efficiency.					

14	In the e-learning environment, well organised materials help me find useful information more quickly.					
15	The on-line learning environment provides rich learning examples and better supports my study.					
16	Relevant e-learning samples of learning tasks can facilitate better my learning progress.					
17	The e-learning environment provides various evaluation formats and helps me better examine my learning effects.					
18	In the e-learning environment, timely evaluation and feedback help me adjust my study quickly and better complete tasks.					
Learning social structure factor scale						
No.	Questions	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
19	In the e-learning environment, the teacher's involvement into activities will impact my enthusiasm.					
20	Communication with instructors via email and video chatting help me solve a lot of learning difficulties.					
21	I believe it is an efficient way to organise on-line learning in the group format.					
22	Communications with other learning partners will impact on my learning enthusiasm.					

Analysis on Reliability and Validity of Scale

In order to ensure the rationality of this scale, 50 undergraduate students from Cangzhou Medical College in China were randomly selected as target subjects, and the test result measure a reliability and validity through a comprehensive analysis (47 effective scales).

Table 2: Results of validity analysis of on-line learning environment factors impacting students learning self-efficacy.

	α factor	Mean	Question no.
Learning content factor scale	0.807	0.805	8
Learning support factor scale	0.847	0.846	10
Learning social structure factor scale	0.771	0.775	4

Reliability is an important indicator for judging the efficacy of a measurement tool, and it can be divided into *external reliability* and *internal reliability*. In multiple-item scales, internal reliability is particularly crucial. It is used to measure whether a number of questions are measuring the same trait, usually expressed as an α coefficient (or Cronbach coefficients). In this study, SPSS11.5 is used to analyse its reliability and the findings are 0.807, 0.847 and 0.771 (Table 2), indicating the scale surveys with high internal consistency and very reliable.

Validity is an important indicator to evaluate the extent to which a measuring tool accurately measures subjects analysed. In this study, the authors first conducted a content validity analysis for the test results. Content validity analysis refers to whether the questionnaire can represent the content or subject of study. Usually, statistical methods are applied; namely, calculating correlation coefficients for each question score and total score, and analysing whether it is significant to indicate its validity [10].

Table 3 shows statistical results of content validity analysis on the *learning content factor scale* (see Table 3, located at the end of this paper). It can be found that the correlation coefficients for each question score and total score are significant at 0.01 level and, therefore, no question needs to be deleted. The same results are in *learning support factor scale* and *learning social structure scale* and none of the questions is invalid to be remove. In other words, preparation of initial scale has a high rationality and can be used directly in the subsequent investigation.

To explore the measurement results further, and whether there are corresponding relationships of some kind of structure among the scale items, construct validity should be carried out. One commonly used method is factor analysis. The key of factor analysis is an observation matrix of loading and a rotated component matrix. If a large load factor appears only on a single variable, then, this factor can be represented by this variable and its connotation can be used for explanation. When load factor appears on several variables, the factor can be expressed by a combination of those variables and its meaning can be explained by their common attributes [11].

Table 4: *Learning content factor scale* factor analysis result.

Variable	Factor F_1	Factor F_2	Commonalities h^2	Variances ó ^{2}
X_1	0.871	0.037	0.761	0.239
X_2	0.660	0.343	0.554	0.446
X_3	0.666	0.248	0.505	0.495
X_4	0.208	0.657	0.475	0.525
X_5	-0.006	0.806	0.650	0.350
X_6	0.474	0.564	0.543	0.457
X_7	0.739	0.112	0.559	0.441
X_8	0.232	0.729	0.585	0.415
Variance Contribution g ^{2}	2.506	2.125	4.631	3.369
Variance contribution %	31.33	26.56	57.89	42.11

Table 4 is the factor analysis result for the *learning content factor scale*. It shows that for Factor 1, the large loads are X_1, X_2, X_3 and X_7. With a further look at the contents of these questions, the common attribute is investigating whether the learning content organising structure could trigger individual interests and motivations, and other perceptions. It can be referred to as: *learning content organising structure*. For Factor 2, the large loads are X_4, X_5, X_6 and X_8. Its common attribute is investigating whether learning content can meet the general perception of individual learning needs. It can be referred to as: *learning content applicability*.

Similarly, on the *learning support factor scale*, two factors (*learning support availability* and *easy use of learning support*) can be extracted, while only one key factor can be extracted from the *learning social structural scale* factor analysis and that is *interactive form of learning*. Thereby, five environmental factors can have an impact on college students' learning self-efficacy: *learning content organising format*; *learning content applicability*; *learning support availability*; *easy use of learning support*, and *interactive form of learning*. It forms a foundation for a subsequent statistical analysis.

PROCESS AND ANALYSIS

Basic Situation of Survey Subjects

Based on principles of stratified sampling, college students from Cangzhou Medical College, Cangzhou Normal University and Agricultural University of Hebei Province were selected as survey subjects. 800 questionnaires were distributed and 749 returned, with the recovery rate of 93.63%. Among them, there were 686 valid questionnaires, and the effective rate is therefore 91.59%. The basic situation of survey subjects is shown in Table 5.

Table 5: Basic demographics of survey subjects.

		Number	Ratio (%)
University	Cangzhou Medical College	182	26.5
	Cangzhou Normal University	264	38.5
	Agricultural University of Hebei	240	35.0
Sex	Male	401	58.5
	Female	285	41.5
Grades	2012	86	12.5
	2013	267	38.9
	2014	252	36.7
	2015	81	11.8

Relation Analysis between On-line Learning Environments and Students Learning Self-Efficacy

Descriptive Analysis of On-line Learning Environments and Students Learning Self-Efficacy

Table 6: Descriptive analysis of the on-line learning environment and students learning self-efficacy.

	Mean	SD
Learning content organising format	3.67	0.900
Learning content applicability	3.81	0.844
Learning support availability	3.70	0.888
Easy use of learning support	3.64	0.913
Interactive form of learning	3.56	0.998
Total	3.65	0.932

Under this study, the authors conducted a descriptive analysis of all the scales, firstly to investigate whether the on-line learning environment can have an impact on students' learning self-efficacy. The analysis result is shown in Table 6. The scores for *learning content organising format*, *learning content applicability*, *learning support availability*, *easy use of learning support*, *interactive form of learning*, were 3.67; 3.81; 3.70; 3.64 and 3.56, respectively. The overall mean was 3.65. (Note: 3 is the reference mean in Likert 5-point scale). It shows that above five factors can generate a certain degree of influence on learning self-efficacy. To what degree? How do they interact with each other? To understand these questions, a further correlation analysis is conducted in this research.

Correlation Analysis of On-line Learning Environment and Students Learning Self-Efficacy

Correlation analysis is a statistical method based on relations among variables of sample database, and it is usually represented by Pearson coefficient. Experience tells that, since there is a positive correlation between each variable in this study, a one-sided test should be adapted. The test results are shown in Table 7.

Table 7: Correlation analysis of on-line learning environment factors and learning self-efficacy.

		Learning content organising format	Learning content applicability	Learning support availability	Easy use of learning support	Interactive form of learning	Learning self-efficacy
Learning content organising format	Pearson correlations	1	0.706**	0.617**	0.592**	0.475**	0.576**
	Significance (two sides)		0.000	0.000	0.000	0.000	0.000
	N	686	686	686	686	686	686
Learning content applicability	Pearson correlations	0.706**	1	0.625**	0.596**	0.420**	0.514**
	Significance (two sides)	0.000		0.000	0.000	0.000	0.000
	N	686	686	686	686	686	686
Learning support availability	Pearson correlations	0.617**	0.625**	1	0.703**	0.508**	0.541**
	Significance (two sides)	0.000	0.000		0.000	0.000	0.000
	N	686	686	686	686	686	686
Easy use of learning support	Pearson correlations	0.592**	0.596**	0.703**	1	0.474**	0.583**
	Significance (two sides)	0.000	0.000	0.000		0.000	0.000
	N	686	686	686	686	686	686
Interactive form of learning	Pearson correlations	0.475**	0.420**	0.508**	0.474**	1	0.396**
	Significance (two sides)	0.000	0.000	0.000	0.000		0.000
	N	686	686	686	686	686	686
Learning self-efficacy	Pearson correlations	0.576**	0.514**	0.541**	0.583**	0.396**	1
	Significance (two sides)	0.000	0.000	0.000	0.000	0.000	
	N	686	686	686	686	686	686

Note: ** significant correlation at 0.01 level (one side)

Table 7 shows that there are clear positive correlations between five environment factors and learning self-efficacy: learning content organising format, learning content applicability, learning support availability, easy use of learning support and interactive form of learning. Moreover, a clear positive correlation can also be found between each factor. However, since correlation is a non-deterministic covariation relationship and, generally, one variable cannot be used to determine another one accurately. Thus, regression analysis is conducted for further analysis in order to verify the relationships between five environment factors and learning self-efficacy.

Regression Analysis of Relations of Learning Self-Efficacy and On-line Learning Environment

Regression analysis is a statistical method used to analyse uncertain covariation relations among variables. Since this study involves multiple variables and their impact on one variable, regression analysis should be applied. The regression analysis process can be summarised as below: to observe the scatter plot, to see whether variables need

to be changed; observe squared correlation coefficient R^2 (that is, the percentage of response variable variation that is explained by independent variable variation); form regression formula; evaluate and explain regression formula.

Taking the relationship between the *learning content factor* and learning self-efficacy as an example: as explained previously, the learning content factor can be divided further into two sub-factors: *learning content organising format* and *learning content applicability*. Those two factors can be used as independent variables, with learning self-efficacy as the dependent variable in the regression analysis. Based on the *learning self-efficacy-learning content organising format* scatter spot, and the *learning self-efficacy-learning content applicability* scatter spot, the distributions are in the shape of an inclined strip, therefore, there is no indicator that the formula should be changed and no need to change variables of *learning content organising format* and *learning content applicability* and R^2 can be used directly in the calculation.

Table 8: Model summary and regression significant valuation.

Model	R	R^2	Adjusted R^2	Standard error	Change statistics					Durbin-Watson
					R^2 change	F change	df1	df2	sig. F change	
1	0.576	0.332	0.331	0.57139	0.332	339.622	1	684	0.000	1.683
2	0.595	0.355	0.353	0.56199	0.023	24.048	1	683	0.000	

Table 8 shows the results of swapping variables by using regression analysis gradually. It can be seen that the first element in the regression formula is learning content organising format. It shows that the learning content organising format has the greatest impact on learning self-efficacy under the e-learning environment. It indicates that study interests, confidence and learning initiatives of college students can be increased and enhanced by introducing vivid animation, images and videos through the on-line learning environment.

Model 1 contains only one factor, *learning content organising format*. $R^2 = 0.332$. Model 2 includes *learning content applicability* based on Model 1. In this new model, $R^2 = 0.355$, there is only 0.023 higher than Model 1. It indicates that *learning content applicability* has little impact on *learning self-efficacy*, and it means that students do not have high recognition that learning content can meet their individual learning needs. This should arouse the teachers' awareness and attention.

Table 9: Estimates of regression coefficients and its significant test.

Model		Unstandardised coefficient		Standardised coefficient	*t*	Sig.	Common linear statistics	
		β	Standard error	Trial version			Tolerance	VIF
1	(Constant)	1.448	0.121		11.952	0.000		
	Learning content organising format	0.598	0.032	0.576	18.429	0.000	1.000	1.000
2	(Constant)	1.085	0.140		7.729	0.000		
	Learning content organising format	0.442	0.045	0.426	9.798	0.000	.501	1.996
	Learning content applicability	0.246	0.050	0.213	4.904	0.000	.501	1.996

Furthermore, from Table 9, Model 2, it can be seen that the regression formula is as below: *learning self-efficacy* = 1.085+0.442* *learning content organising format* + 0.246* *learning content applicability*. It means that if the *learning content applicability* variable stays the same, one single unit change of *learning content organising format* will be transferred into 0.442 unit of learning self-efficacy.

Finally, residual analysis was conducted. Its distribution can be seen as normal because the Durbin-Watson value is 1.683 (see Table 8). It shows that residual results have no serial correlation and the standard residual range should be with -2 and 2, no abnormal points. Therefore, it can be said that the regression formula basically reflects the relationship between *learning self-efficacy* and *learning content organising format* and *learning content applicability*. However, as per Model 2 from Table 8, R^2 (0.355), it shows that *learning content organising format* and *learning content applicability* cannot fully predict self-efficacy, and there are other influencing factors as well, which also matches with above analysis results. (Note: the correlation analysis shows that there is a clear positive correlation between each environment factor. It can be said that those factors work together to generate impacts.)

Similarly, the regression analysis for *learning support factor* and *learning self-efficacy* shows that *learning support availability* has a bigger impact on self-efficacy, while *easy use of learning support* has little impact. It indicates that currently various learning support tools, such as case studies, samples, and other tools do not work well under the *learning service* concept. It is designed not from the actual learning experience of students and, therefore, leads to *gaps* or *separation* for the actual learning process. One should be fully aware of it, and pay attention to it.

CONCLUSIONS

This study shows an analysis of the relationship between an on-line learning environment and students' learning self-efficacy and concludes that three scales, *learning content scale*, *learning support scale* and *learning social structure scale* are compiled and analysed as on-line learning environment factors to self-efficacy. Furthermore, after validity and reliability, three factors can be divided into five elements, which are *learning content organising format*, *learning content applicability*, *learning support availability*, *easy use of learning support* and *interactive form of learning*.

It can be concluded that the three factors *learning content*, *learning support* and *learning social structure* have some degree of impact on learning self-efficacy after being tested using certain statistical methods, including descriptive analysis, correlation analysis and regression analysis. Among the three factors are two learning content sub-factors that are the learning content organising format factor and the learning content applicability factor, where the former has a bigger impact than the later. Similarly, two sub-factors of learning support (that is, learning support availability and easy use of learning support) have different impacts as well, where the former is bigger and the latter is smaller. Moreover, all these factors work together to have an impact on learning self-efficacy.

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Table 3: Correlations between each question score and total score in the *learning content scale.*

No.		X1	X2	X3	X4	X5	X6	X7	X8	Total
X1	Pearson correlations	1	0.485**	0.506**	0.181	0.104	0.410**	0.546**	0.262	0.684**
	Significance (two sides)		0.001	0.000	0.224	0.487	0.004	0.000	0.075	0.000
	N	47	47	47	47	47	47	47	47	47
X2	Pearson correlations	0.485**	1	0.475**	0.399**	0.185	0.326**	0.388**	0.441**	0.725**
	Significance (two sides)	0.001		0.001	0.005	0.212	0.025	0.007	0.002	0.000
	N	47	47	47	47	47	47	47	47	47
X3	Pearson correlations	0.506**	0.475**	1	0.365**	0.181	0.354*	0.285	0.269	0.662**
	Significance (two sides)	0.000	0.001		0.012	0.224	0.015	0.053	0.067	0.000
	N	47	47	47	47	47	47	47	47	47
X4	Pearson correlations	0.181	0.399**	0.365*	1	0.325*	0.284	0.178	0.392**	0.584**
	Significance (two sides)	0.224	0.005	0.012		0.026	0.053	0.231	0.006	0.000
	N	47	47	47	47	47	47	47	47	47
X5	Pearson correlations	0.104	0.185	0.181	0.325*	1	0.468**	0.195	0.397**	0.534**
	Significance (two sides)	0.487	0.212	0.224	0.026		0.001	0.190	0.006	0.000
	N	47	47	47	47	47	47	47	47	47
X6	Pearson correlations	0.410**	0.326**	0.354*	0.284	0.468**	1	0.485**	0.426**	0.723**
	Significance (two sides)	0.004	0.025	0.015	0.053	0.001		0.001	0.003	0.000
	N	47	47	47	47	47	47	47	47	47
X7	Pearson correlations	0.546**	0.388**	0.285	0.178	0.195	0.485**	1	0.206	0.631**
	Significance (two sides)	0.000	0.007	0.053	0.231	0.190	0.001		0.165	0.000
	N	47	47	47	47	47	47	47	47	47
X8	Pearson correlations	0.262	0.441**	0.269	0.392**	0.397**	0.426**	0.206	1	0.655**
	Significance (two sides)	0.075	0.002	0.067	0.006	0.006	0.003	0.165		0.000
	N	47	47	47	47	47	47	47	47	47
Total	Pearson correlations	0.684**	0.725**	0.662**	0.584**	0.534**	0.723**	0.631**	0.655**	1
	Significance (two sides)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
	N	47	47	47	47	47	47	47	47	47

Note: ** significant correlation at 0.01 level