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Influence of WebQuest Teaching on Learners' Learning Performance under the Learning Technology Paradigm

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Abstract

Information technologies represented by 5G and artificial intelligence (AI) have comprehensively permeated into the educational field, driving the high-speed development of educational informatization and leading to the ever-changing learning paths and methods. Apart from abundant online resources, other scientific teaching technologies are required to promote online learning effectiveness. Especially, the key objectives of online teaching lie in improving the online learning depth & efficiency and cultivating learners' lifelong learning ability. As an inquiry learning model based on network environment, WebQuest teaching model can enhance learners' learning interests and attract their attention by virtue of network multimedia resources and multidisciplinary knowledge in teaching activities well planned by teachers, realize teaching objectives, and strengthen their knowledge transfer ability. This study designed a questionnaire regarding the influence of WebQuest teaching under the learning technology paradigm on learners' learning performance. Additionally, it analyzed the effects of six constituent parts of WebQuest teaching on learning performance. Results show that the overall Cronbach's α coefficient of the designed questionnaire is 0.928, indicating good reliability. The average (AVE) values corresponding to seven factors are all greater than 0.5, and the construct reliability (CR) value is constantly higher than 0.7, manifesting good convergent validity. Learners' learning performance is significantly promoted by three aspects—task, process, and resource—in WebQuest teaching. The obtained conclusions have important reference values for reforming teaching models to cultivate students' knowledge transfer ability and enhance their high-order thinking ability and changing and innovating teaching models under the information technology environment.

Keywords: learning technology paradigm, WebQuest, teaching model, learning performance, stepwise regression

1. Introduction

Information technologies have already infiltrated into higher education with the popularization of computer and the Internet, especially the high-speed development of "Internet + education" concept. Superior teaching resources and network information resources are integrated, and curricula and information technologies are fused to strengthen the cultivation of application-oriented and skilled talents. Additionally, autonomous inquiry learning of college students is vigorously advocated. With the outbreak of COVID-19, most college students have to accept the online learning model, and the training and cultivation of students' autonomous learning and innovation capabilities have become one of the main online teaching objectives in universities and colleges. With knowledge currently changing with each passing day, college students must possess the ability to acquire and utilize effective knowledge through autonomous learning and blend themselves into solidarity and cooperation. Only in this situation can they adapt to the future society full of competition. During the curriculum implementation of each discipline in universities and colleges, online teaching approaches are improved to cultivate students' high-o fulltext241532023 rder thinking abilities so that they can learn to learn and promote their lifelong sustainable development. The reform of traditional single teaching approaches not only plays a significant role in cultivating students but also strengthens teachers' pedagogical levels and teaching abilities, contributes to the rapid development of higher education, and exerts positive effects on talent cultivation in higher education.

In the reform of online teaching models, the WebQuest teaching model has become one of reform hotspots, aiming to facilitate learners to correctly utilize information resources and develop high-order thinking abilities such as analysis, synthesis, and evaluation. Task is an important constituent part of the WebQuest teaching model. Such design should be feasible and interesting and should boost the development of learners' high-order thinking abilities. Constructivist learning methods are required to complete tasks. The WebQuest teaching model, an active inquiry-oriented learning model based on network resource environment, can maximize learners' interests in the network to arouse students' learning interests through explicit task goals, exploratory learning activities, continuously emerging challenging problems, and collaboration between partners. Based on constructivist learning theory, the WebQuest teaching model stresses the cultivation of learners' exploring spirit, teamwork consciousness, and information use and problem-solving abilities. The learning technology paradigm is an emerging paradigm in domestic and foreign educational technology research fields in recent years, requiring researchers to pursue the improvement of learners' learning performance

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based on learners with the attention paid to the development of learners. The WebQuest teaching model under the guidance of the learning technology paradigm can comprehensively improve the learning depth and efficiency while cultivating learners' lifelong learning abilities.

2. Theoretical Foundation and Hypotheses Development

2.1 Theoretical Foundation

In WebQuest, the teaching approaches of role play and group activities are adopted, and the thought of cooperative learning is embodied. Slavin [1] believed that cooperative learning is a classroom teaching organization form extensively applied across the world at present. When it comes to cooperative learning, interactions between dynamic teaching factors are systematically utilized to promote learning and attain teaching objectives with learning groups as the basic organization form and group performance as the evaluation criterion. In group activities, heterogeneous groups are generally adopted, but sometimes homogeneous groups or homogeneous + heterogeneous mixed groups are formed according to the property of learning tasks, learning materials, and learning objectives. In addition, cooperative learning is a teaching activity based on power resources, i.e., interaction and cooperation between dynamic teaching factors. As required by cooperative learning, all dynamic teaching factors should keep interactions, especially cooperative interactions, thus promoting the teaching progress. As a teaching activity with group performance as the reward basis, cooperative learning takes the overall performance of each group in the process of reaching objectives as the evaluation and reward criterion. This mechanism can transform the competition between individuals into that between groups to promote intragroup cooperation. As a result, students can do their upmost in their respective groups and achieve maximum development.

2.2 Hypotheses development

The WebQuest teaching model is an inquiry-oriented teaching activity by course units using Internet resources. In such an activity, all or most information used by students are acquired from the Internet. In this type of curriculum plan, the students are presented with a specific hypothetical situation or a task, which not only can be a problem needing solution but also a project needing completion. In curriculum planning, students are provided with required resources that can guide them to complete tasks and inform them of the future evaluation method. Moreover, the ways to further curriculum development are generalized, and students are required to obtain creative solutions by analyzing and synthesizing information. The WebQuest teaching model can largely be divided into six modules: Introduction, Task, Process, Resources, Evaluation, and Conclusion, all of which are mutually associated to form a complete teaching system. As for how the six modules in the WebQuest teaching model influence learners' learning performance, Chang et al. [2] proved the influence of the WebQuest teaching model on the learning performance in environmental education. Results show that students' learning performance is positively influenced by WebQuest in outdoor teaching. When WebQuest is applied to practical teaching, students can acquire further knowledge and experience and cultivate their own critical thinking abilities. Zheng et al. [3] thought that WebQuest, an inquiry-oriented network learning method, exerts a good promoting effect on those receiving higher education. Hassanien [4] discussed an entry-level WebQuest technology aiming to teach students and improve their learning performance. Survey results manifest that the WebQuest teaching technology can enhance students' learning abilities with some proposed suggestions on further development of students. Hence, this research proposed H1 as follows:

H1: Introduction in the WebQuest teaching model under the learning technology paradigm has an evident positive promoting effect on learners' learning performance.

According to Simina et al. [5], the WebQuest teaching technology makes achieving good performance possible for project-driven language learning. Zacharia et al. [6] thought that the WebQuest teaching technology can enhance students' understanding of the concept of CO_2-friendly houses. Hassanien [7] evaluated the effectiveness of WebQuest as a computer-based learning (CBL) tool in supporting students' learning in HE. As revealed by the research results, the WebQuest design exhibits some marked advantages and provides an additional abundant learning environment. Students think that WebQuest remarkably enhances their learning abilities. Therefore, H2 was put forward.

H2: Task in the WebQuest teaching model under the learning technology paradigm generates an apparent positive promoting effect on learners' learning performance.

Sanford et al. [8] deemed that WebQuest, an inquiry-based learning activity, can provide several opportunities for nurses to learn how to analyze and synthesize key information and render an exciting online teaching strategy. Yang [9] performed WebQuest teaching in the experimental group through the quasi-experimental research method and implemented the traditional IT integrated curriculum teaching in the control group. Research results show that students subjected to the WebQuest model learning have better learning performance than those adopting the traditional IT integrated curriculum teaching. Çığrık et al. [10] pointed out that WebQuest is a teaching approach based on constructivist educational philosophy, and results manifest that the WebQuest teaching technology can effectively strengthen students' logical thinking abilities. Given this context, H3 was raised.

H3: Process in the WebQuest teaching model under the learning technology paradigm exerts an obvious positive promoting effect on learners' learning performance.

Allan et al. [11] analyzed the influence of the phased integration of knowledge base into WebQuest on learning in higher education. Results show that the WebQuest teaching model indeed can potentially facilitate high-order learning. Iskeceli-Tunc et al. [12] designed the WebQuest task to improve the high-order thinking skills of six in-service teachers and put forward an effective professional development module for in-service teachers. According to the research findings of Bayram et al. [13], students supported by the WebQuest teaching model display clearer critical thinking consciousness. The research results of Drozd et al. [14] showed that undergraduate nurses hold positive attitudes toward the WebQuest teaching model, which can enhance their degree of participation. Hence, H4 was proposed.

H4: The Resources module in the WebQuest teaching model under the learning technology paradigm has an evident positive promoting effect on learners' learning performance.

According to the results of Osman [15], teachers highly cognize the technology, contents, and teaching structure of WebQuest. BinTaleb [16] discussed the opinions of teachers and students over WebQuest implementation experience, and results reveal that WebQuest can serve as a suitable web-based teaching tool to learn Islam and Islamic civilization. Şahin et al. [17] discussed about the influences of WebQuest media-supported 5E learning model on students' performance and satisfaction, and results reflect that the WebQuest media-supported 5E learning model facilitates student to learn, meets their learning needs, enhances their learning motivation, and generates positive influences on their learning outcomes. Averkieva et al. [18] thought that WebQuest can help improve students' learning motivation and stimulate their critical thinking ability in professional foreign languages. On this basis, H5 was put forward.

H5: Evaluation in the WebQuest teaching model under the learning technology paradigm exerts an apparent positive promoting effect on learners' learning performance.

According to the opinion of Wang et al. [19], teachers need to systematically design and develop curriculum activities based on WebQuest. Sumtsova et al. [20] thought that the WebQuest teaching model organizes teaching activities through the latest Internet technologies, which can enhance students' motivation to learn foreign languages. Synekop [21] deemed that the WebQuest learning method used by English teachers in differentiated teaching helps diversify the English learning styles in universities of science and technology and promotes the development of professional communication skills. Spian et al. [12] investigated students' cognition of WebQuest and cooperative learning. Results reveal that WebQuest generates positive influences on students' learning when applied to Islamic education and teaching. Therefore, H6 was proposed.

H6: Conclusion in the WebQuest teaching model under the learning technology paradigm exerts an evident positive promoting effect on learners' learning performance.

According to the existing research literatures, WebQuest highlights learners' abilities to correctly utilize information resources and develop high-order thinking abilities such as analysis, synthesis, and evaluation. Task, an important constituent part of the WebQuest teaching model, is supposed to promote the development of learners' high-order thinking abilities. Teachers should lead students to take an active part in the learning process and exchange learning materials with each other. This activity stresses observation, data collection, hypothesis verification, and collaborative learning of students, in which students should be autonomous learners. Therefore, the research hypotheses regarding the above six aspects were put forward.

3. Methodology

3.1 Questionnaire design

This research designed a questionnaire regarding the influence of WebQuest teaching on learners' learning performance under the learning technology paradigm, including the following three aspects. First, this research surveyed the basic information of respondents, such as gender, grade, specialty, and school. The second aspect is the core content of this questionnaire, which mainly aimed to measure the WebQuest teaching technology, including Introduction, Task, Process, Resources, Evaluation, and Conclusion, which were measured using 4, 5, 4, 4, 4, and 3 questions. The third aspect aimed to measure learners' learning performance. The five questions in the questionnaire designed by Hwang et al. [23] were adopted and designed using Likert 5-point scale. According to the degree of recognition, each question was divided into five grades: "totally agree," "relatively agree," "agree," "not agree too much," and "not agree at all," to which 5-1 points were assigned, respectively. The data were analyzed via SPSS 26.0.

3.2 Research objects

Jiangsu Province is a relatively developed province in higher education in the southeast coastal region of China, in which both educational informatization reform and teaching model reform have taken the lead in China's higher education. In recent years, Jiangsu Province has continuously enhanced the online teaching model reform of higher education, promoted all kinds of leading-edge teaching models, and made remarkable achievements. Especially with the comprehensive implementation of China's Emerging Engineering Education strategy, some engineering universities in Jiangsu Province have carried out key teaching model reform to meet national strategic development needs. Therefore, this research investigated related engineering specialties in six engineering universities (Changzhou University, Changzhou Institute of Technology, Jiangsu University of Technology, Nanjing University of Posts and Telecommunications, Nanjing Tech University, and Nanjing University of Information Science & Technology) in Jiangsu Province. The questionnaire was designed on a common third-party online questionnaire platform in China, the QR code was then generated, and questionnaires were distributed by the research group to students from the six universities. Students directly answered questions by identifying the QR code at mobile terminal. A total of 368 questionnaires were recovered, and 286 ones were reserved after invalid ones with same answers on the same questionnaire sheet or incomplete answers with an effective rate of 77.72%.

Table 1. Descriptive statistical results of respondents

Name	Option	Frequency	Percentage (%)
Gender	Female	118	41.26
	Male	168	58.74
Grade	Freshman	50	17.48
	Sophomore	85	29.72
	Junior	108	37.76
	Senior	43	15.03

Specialty	Digital media technology	43	15.03
	Computer science and technology	49	17.13
	Software engineering	18	6.29
	Network engineering	40	13.99
	Electronic information engineering	11	3.85
	Communication engineering	94	32.87
	IoT engineering	31	10.84
School	Changzhou University	44	15.38
	Changzhou Institute of Technology	20	6.99
	Jiangsu University of Technology	59	20.63
	Nanjing University of Posts and Telecommunications	64	22.38
	Nanjing Tech University	67	23.43
	Nanjing University of Information Science & Technology	32	11.19

4. Results Analysis

The questionnaire had validity as evidenced by the validity analysis. Reliability indicates the consistency between repeated measurement results, and validity denotes the reliability of results. In SPSS 26.0, reliability analysis was acquired by measuring the Cronbach's α coefficient. If the Cronbach's α coefficient was higher than 0.8, it reflects the high reliability of questions in this questionnaire.

Table 2. Reliability results

Variable name	Number of questions	Cronbach's α coefficient	Cronbach's α coefficient
Introduction	4	0.887	
Task	5	0.913	
Process	4	0.882	
Resources	4	0.891	0.928
Evaluation	4	0.959	
Conclusion	3	0.890	
Learning performance	5	0.928	

As seen in Table 2, the overall Cronbach's α coefficient was 0.928, which was higher than 0.9. Meanwhile, the Cronbach's α coefficient of each variable was also higher than 0.8, indicating the very excellent overall reliability.

Table 3. Validity result

KMO		0.878
Bartlett sphericity test	Approximate Chi-square	7205.272
	df	406
	p value	0

From Table 3, the KMO value was 0.878, and the *p* value of Bartlett sphericity test was 0.000, which was smaller than 0.01, indicating excellent validity.

Table 4. AVE and CR results of model

Variable	AVE	CR
Introduction	0.673	0.891
Task	0.686	0.916
Process	0.682	0.892
Resources	0.687	0.897
Evaluation	0.854	0.959
Conclusion	0.732	0.891
Learning performance	0.739	0.934

As could be obtained from Table 4, the AVE values corresponding to seven factors were all greater than 0.5, and all CR values were higher than 0.7, meaning the good convergent validity of the analysis data.

Table 5. Discriminant validity

	Introduction	Task	Process	Resources	Evaluation	Conclusions	Learning performance
Introduction	0.820	-	-	-	-	-	-
Task	0.544	0.828	-	-	-		-
Process	0.261	0.320	0.826	-	-	-	
Resources	0.400	0.302	0.357	0.829	-	-	-
Evaluation	0.458	0.482	0.246	0.293	0.924	-	-
Conclusion	0.383	0.296	0.278	0.509	0.387	0.855	-
Learning performance	0.229	0.256	0.237	0.214	0.354	0.265	0.859

From Table 5, the AVE values of all the seven variables were greater than the maximum absolute value of correlation coefficient between factors, meaning their good discriminant validity.

Given the substantial number of independent variables, the stepwise regression method was adopted to automatically identify significant independent variables. The model passed *F* test, indicating its validity.

Table 6. Stepwise regression result

Variable	Standardization coefficient	*t*	*p*	VIF	R^2	Adjusted R^2	*F* value
Constant	-	7.478	0.000**	-	0.161	0.152	F(3,282) = 18.079, *p* = 0.000
Task	0.121	2.006	0.046*	1.228			
Process	0.274	4.568	0.000**	1.206			
Resources	0.136	2.372	0.018*	1.111			

Note: D-W: 1.459; * $p<0.05$ ** $p<0.01$.

(1) H1 was not true, indicating that Introduction of WebQuest teaching under the learning technology paradigm has an evident positive promoting effect on learners' learning performance. The main reason is that the

Introduction link of curricula is first required in the WebQuest teaching model. As a critical step in the teaching process, this link aims to help learners set up positive attitudes toward classroom learning activities. In online learning, however, learners do not face the teachers. Thus, without directly facing teachers and classmates, learners' online learning attitudes and communication will have a direct influence on learners' learning ability and learning efficiency. In the Introduction link of WebQuest teaching, teachers also need to independently develop and design learning scenarios adaptive to online learning, and the problem situation is associated with students' past experience and existing knowledge. Another potential reason why H1 does not hold true is that teachers may not effectively establish any learning problem situation for learners.

(2) H2 was true: Task in the WebQuest teaching model under the learning technology paradigm exerts an obvious positive promoting effect on learners' learning performance. The reason for this finding is explained as follows: after the teaching process is completed, learners acquire concrete results by solving concrete problems. The task completion results can be presented through group cooperation via display and oral reporting, which can motivate learners' passion for learning knowledge and promote the cultivation of their high-order thinking abilities. Meanwhile, learners need to prepare the display and reporting materials such as essays, PPTs, videos, and pictures when completing their learning tasks online. In WebQuest teaching, therefore, teachers will scientifically and systematically design a good learning task. When completing such task, students need to make decisions through high-order thought to improve their abilities to comprehensively process information, judge and analyze problems, create results, and solve problems. This scenario is feasible and very attractive for students, while learners' learning performance can be comprehensively improved.

(3) H3 was true: Process in the WebQuest teaching model under the learning technology paradigm exerts an obvious positive promoting effect on learners' learning performance. This finding is mainly because in WebQuest teaching, Process describes the detailed WebQuest learning steps among learners who will be more occupied in exploratory learning activities. The teacher will decompose the learning task into several progressive small learning tasks, which are then decomposed into several steps. The more definite the teacher designed process, the more obvious the teaching effect, and the more obvious learners' learning performance. In this link, the teacher should clearly and specifically describe the sequence and concrete steps taken by learners to complete tasks and provide guidance and prompts for learners, including the idea, method, and suggestions to solving problems.

(4) H4 was true: The Resources module in the WebQuest teaching model under the learning technology paradigm has an evident positive promoting effect on learners' learning performance. This finding is mainly because in online learning, more learners need to efficiently utilize resources. Hence, the teacher will prepare teaching resources and information resources facilitating learners to smoothly complete tasks for learners before class. Such resources can be network resources such as websites and databases or non-network resources such as books, films, posters, and models of each discipline and specialty. Meanwhile, teachers can be encouraged to acquire information resources by visiting professor-assisted teaching and field investigation. The more abundant resources will help learners to largely improve their learning performance.

(5) H5 was not true: Evaluation in the WebQuest teaching model under the learning technology paradigm exerts an apparent positive promoting effect on learners' learning performance. A possible reason is that in online learning, more learners pay attention to the learning process while neglecting the learning evaluation. In reality, the evaluation module aims to evaluate the learning process learners participate in and their learning effect, and the main evaluation methods include learner self-evaluation, group member evaluation by the whole group, mutual evaluation, and teacher evaluation. In practical teaching, however, teachers neglect the evaluation of teaching process and simply take the one-time test result of learning results as the teaching evaluation result. Consequently, the accuracy and fairness of learning process evaluation are not completely ensured, thus reducing learners' learning motivation. This finding also enlightens teachers dedicated to higher education to design corresponding evaluation criteria for each link in the learning process and unite three parties—teacher, group member, and student—to score each index, thereby making a more scientific and reasonable objective evaluation.

(6) H6 was not true: Conclusion in the WebQuest teaching model under the learning technology paradigm exerts an evident positive promoting effect on learners' learning performance. This finding is mainly because the Conclusion actually means summarizing the phased learning effect of learners and marks the end of the whole exploratory learning process. In this link, however, summarizing and reflecting upon the exploratory learning activities are important for learners and teachers. Moreover, the summary and reflection made by learners are especially important. Owing to the heavy online learning task load and long learning time, learners may fail to effectively summarize the problems encountered in the learning process, completion status, learned knowledge, and experience. Except for summarizing the exploratory learning process and results, teachers may not guide students to extend exploratory learning experience into other knowledge domains. Consequently, learners' knowledge expansion and transfer are not effectively realized, thus lowering their learning performance.

5. Discussion

Thanks to the WebQuest teaching model, learners can utilize network multimedia resources and multidisciplinary knowledge to actively carry out autonomous and exploratory learning and proactively establish knowledge in teaching activities well planned by teachers. In general, the WebQuest teaching model includes numerous aspects. Thus, its constituent parts should be more effectively integrated. Schweizer et al. [24] thought that the modules of the WebQuest teaching model are mutually associated, thus forming a complete teaching system. Hence, further attention should be paid to the following six aspects of the WebQuest teaching model. First, create situations: The Introduction module should aim to introduce background information related to the learning subject, motivate learners' learning interests, and guide learners to be actively engaged in their learning state. Second, define tasks: Tasks should be designed on the basis of learners' existing knowledge and experience and should arouse learners'

further exploratory motivation and promote the development of their high-order thinking. Third, provide resources: Resources are the carriers for learners to master knowledge, abundant resources constitute an important condition for completing learning tasks, and the resources provided should be closely related to the subject and convenient for learners to carry out research on such a subject. Fourth, process guidance: The Process module provides learners with steps needed to complete tasks and guides learners to think and explore problems similar to what researchers do. Fifth, evaluation and exchange: Evaluation refers to identifying and evaluating learners' learning behaviors and results; multiple evaluations can effectively promote the mutual exchange between learners and enhance their recognition capability and judgment capability. Six, conclusion and reflection: Conclusion refers to the generalization of the whole exploratory learning activity; after the project task is completed, conclusion and reflection facilitate learners to reflect upon the exploration process so that the learning activity can proceed more profoundly. Under the current background of COVID-19, the WebQuest teaching model needs to create learning situations through technologies, integrate learning contents into learning situations, and set up virtual environments for learners. During the continuous and dynamic interaction with such environments, learners can fully stimulate their potentials and comprehensively utilize their wisdom to understand learning contents, develop their creative thinking, strengthen their cooperative consciousness and responsibility consciousness, continuously enhance and sublimate learners' behaviors and abilities, and improve their learning performance.

6. Conclusion

The year-by-year elevation of educational informatization level lays a good foundation for the online education model reform. One of the main objectives of online learning lies in integrating information technologies with curricula to strengthen learners' autonomous exploration capabilities. The WebQuest teaching model refers to creating learning situations that will guide students to explore and complete tasks through network resources, promoting students to play the dominant role in learning situations, and arousing their attention to and reflection upon practical problems. This research analyzed the influences of six constituent parts of WebQuest teaching on learning performance. The research results manifested that the overall Cronbach's α coefficient was 0.928, indicating good reliability. The KMO value was 0.878, and the P value of Bartlett sphericity test was 0.000, manifesting excellent validity. Learners' learning performance can be significantly promoted by three aspects—task, process, and resources—in WebQuest teaching. The WebQuest teaching model may be combined with flipped classroom. Control experiments can be carried out with or without the WebQuest teaching model, and this model can be applied to concrete curriculums, among others.

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