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Effecting an Adaptive Learning System on Academic Achievement as Regulations for Measuring Pharmacist Qualifications to Licensure of Pharmaceutical Management Students

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Abstract

Background and Aims: On March 15, 1994, China began implementing the qualification system for practicing pharmacists. Pharmaceutical management and regulations course is a compulsory course for students majoring in pharmacy. It is also one of the mandatory subjects for the licensed pharmacist qualification examination. The objective of this study is to (1) compare students' academic achievements before and after learning through an adaptive learning system. (2) To compare students' academic achievements after learning through an adaptive learning system with the criterion set at 70 percent. And (3) To assess the student's satisfaction with the adaptive learning system.

Methodology: This study used a cluster sampling method with 30 students as the sample. The research tools are: (1) Course lesson plan, (2) Academic achievements test paper, (3) Student satisfaction questionnaire. Conduct pre-test and post-test on the sample using academic performance papers, and analyze the mean, standard deviation, and single sample t-test of the data using SPSS.

Result: After using the adaptive learning system: (1) Students' academic achievements were significantly higher than before use, with a statistically significant difference of 0.05; (2) The student's academic achievements are above the 70% standard, and the difference is statistically significant at 0.05; and (3) Improved student satisfaction.

Conclusion: Through adaptive learning system classroom practice, learning efficiency has been improved and the personalized learning needs of students have been met. Helps to improve academic achievements among students and win their popularity.

Keywords: Effecting an Adaptive Learning System; Academic Achievement; Regulations for Measuring Pharmacist Qualifications as Licensure; Pharmaceutical Management Students

Introduction

Pharmaceutical Management and Regulations is a compulsory course for undergraduate and junior college students majoring in pharmacy and traditional Chinese medicine in pharmaceutical colleges and universities. It is also one of the compulsory subjects for the national licensed pharmacist qualification examination. The course knowledge system is essential in pharmaceutical practice activities, and the content is closely related to the latest national laws and regulations related to pharmaceutical management. It mainly teaches the development, production, operation, and use of drugs Current legal systems, and drug policies

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in regulatory and other fields.

China began implementing the qualification system for licensed pharmacists on March 15, 1994. The National Medical Products Administration shall be responsible for the control, supervision, and administration of access to the practicing qualification of pharmaceutical technicians in the drug production, marketing, and use units. Units engaged in the production, trading, use, and other pharmaceutical services shall be equipped with corresponding licensed pharmacists by regulations. The National Drug Administration is responsible for making clear regulations on the positions that need to be held by licensed pharmacists. National Medical Products Administration (2020), National Medical Products Administration issued the Notice on Regulating the Allocation and Use of Licensed Pharmacists by Drug Retailers, which proposed to "adhere to the allocation policy of licensed pharmacists and steadily improve the allocation level".

Licensed Pharmacist refers to the examination system that has passed the national unified examination, obtained the Professional Qualification Certificate of Licensed Pharmacist of China, and been registered. In principle, exams are held once a year. According to the annual statistical data of the National Medical Products Administration and the Internet, the passing rate of the licensed pharmacist qualification examination in the past 11 years was only higher than 20% in three years, with an average passing rate of 19.84% (CQLP, 2023). detailed data is shown in the table below;

Artificial intelligence, as an important driving force for leading a new round of technological revolution and industrial transformation, has given birth to a large number of new products, technologies, and models, and has also brought more possibilities to modernize education. The Chinese government attaches great importance to the development of artificial intelligence and education. State Council of China (2017) issued a notice on the development plan for the new generation of artificial intelligence, which pointed out the need to use intelligent technology to accelerate the reform of talent training models and teaching methods and build a new education system including intelligent learning and interactive learning. Building an online learning and education platform based on big data intelligence. Develop a comprehensive education analysis system. Establish a learner-centered educational environment, provide precise educational services, and achieve customization of daily and lifelong education.

Ministry of Education of China (2018) issued a notice on the Action Plan for Artificial Intelligence Innovation in Higher Education Institutions, which pointed out the need to promote the development of intelligent education. Explore new teaching models based on artificial intelligence, utilizing AI to monitor the teaching process, analyze learning situations, and diagnose academic levels. Establish a multi-dimensional comprehensive intelligent evaluation based on big data, accurately evaluate teaching and learning performance, and achieve personalized teaching; Promote the transformation of school governance methods, promote lifelong online learning, encourage the development of learner-centered intelligent learning platforms, provide rich personalized learning resources, innovate service supply models, and achieve personalized lifelong education.

LI et al., (2018) Adaptive learning system refers to the use of artificial intelligence technology to detect students' current learning status and knowledge level, and predict their future learning trends, to intelligently recommend the best learning content and learning path to meet students' personalized learning philosophy. The Adaptive learning system refers to a learning system that intelligently identifies students' Learning styles and other personality characteristics in a data-driven way, uses emerging technologies such as Knowledge graphs to deeply diagnose students' learning, and provides real-time, dynamic, intelligent, and personalized guidance to meet students' personalized needs.

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Based on this, this study attempts to introduce an adaptive learning system into the teaching of licensed pharmacist exams, pharmaceutical management, and regulations courses, to improve students' academic achievements, improve teachers' educational concepts, promote teaching method reform, establish a learner-centered educational environment, and promote the deep integration of artificial intelligence technology and education.

Research questions

1. How are the student's academic achievements before and after learning through an adaptive learning system?

2. How are the student's academic achievements after learning through an adaptive learning system compared with the determined criterion at 70 percent?

3. What is the student's satisfaction with the adaptive learning system after learning?

Research objectives

1. To compare students' academic achievements in pharmaceutical management and regulations courses before and after learning through an adaptive learning system.

2. To compare students' academic achievements in pharmaceutical management and regulations courses after learning through an adaptive learning system with the criterion set at 70 percent.

3. To assess the student's satisfaction with the adaptive learning system.

Literature Review

The research on adaptive learning in Western countries, led by the United States, started earlier. In the 1980s, the concept of adaptive learning emerged in relevant literature. In the early 1990s, there was a small upsurge in research in related fields, with a significant increase in the number of literatures. With the development of big data and artificial intelligence technology, adaptive learning systems are gradually becoming mature.

Brusilovsky (1996) proposed that adaptive learning is based on individual differences in learners' own prerequisite knowledge, learning level, learning style, learning attitude, and learning ability.

With the support of emerging technologies such as big data and cloud computing, adaptive learning has emerged, overturning traditional learning models and committed to providing students with personalized learning experiences. It implements the educational concept of "student-centered" and provides dynamic support for learning resources, learning methods, learning content, and other aspects based on individual differences among students. (Somyurek 2015)

Zhou & Wen (2020) believes that adaptive learning is an innovation at the conceptual level, and adaptive learning systems are enabled by technology based on this concept. The relationship between the two is abstract theory and concrete practice, and they are also an inseparable whole. The concept of adaptive learning has practical value only through the operation of adaptive learning systems, and adaptive learning systems need to contain the concept of adaptive learning to have theoretical significance. that adaptive learning system provides a practical paradigm for personalized learning and realize the idealized education of individualized teaching. It starts with preliminary tests and ends with learning tutoring, forming a personalized learning loop that includes "testing learning practice evaluation assistance". The aim is to enable students to firmly acquire each knowledge point based on their differences and improve learning efficiency.

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De Bra, et al. (1999) proposed a reference system model for AHS. In this Adaptive Hypermedia Application Model (AHAM) reference model, AHS consists of four basic components: DM (Domain Model), UM (User Model), PM (Pedagogical Model), and AE (Adaptive Engine).

The above analysis indicates that scholars from both China and the West have conducted extensive research and exploration of the concept, theory, characteristics, composition, and teaching application of adaptive learning systems. These studies have laid a solid foundation for the future research, development, and application of adaptive learning systems.

Research Conceptual Framework

Based on the content of this study, The independent variable is adaptive learning system management based on Constructivist Theory and Mastery Learning Theory (Chen, 2021). The dependent variables are Students' academic achievements and student satisfaction (Ye, 2019).

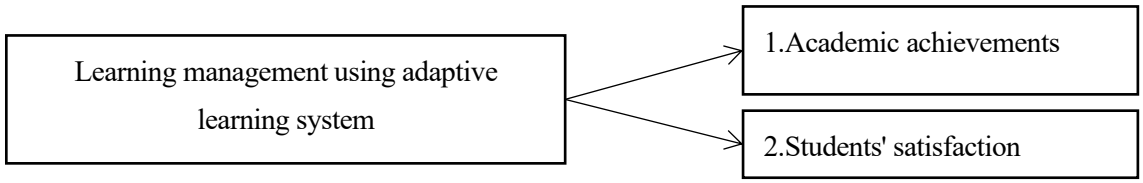

Figure 1 Research Conceptual Framework

Methodology

1. Population and sample

1.1 The population in this study was 60 students (2 classes, each with 30 students) from the licensed pharmacist qualification exam at Beijing Lianmi Education and Training Institution. (2024)

1.2 The sample of this study was 30 students from class 1 of the Beijing Lianmi Education and Training Institution Certified Pharmacist Qualification Examination a sample and uses cluster random sampling method for sampling.

2. Research instruments

Research instruments were the tools for collecting data. The research instruments which were used in this study were:

2.1 Instruments for measuring Students' academic achievements

Evaluate adaptive learning systems pharmaceutical management and regulations course. The researcher created the evaluation form of lesson plans.

2.1.1 An expert group composed of five experts evaluates the evaluation form. The five experts include two experts in computer-related fields, one expert in pharmaceutical-related fields, one expert in law-related fields, and one expert in pedagogy-related fields. After collecting data, analyze the collected data to determine the appropriateness and consistency of the lesson plans. If the average score of appropriateness and consistency assessed by a group of experts is higher than 3.51, it means that the components of the lesson plans have good appropriateness quality and internal consistency. After obtaining the expert evaluation results, the developed teaching model was revised and improved according to the expert's suggestions.

2.1.2 It was found that the mean score of appropriateness was at 4.53 and the standard deviation was at 0.60 which means the lesson plans had the quality at a very high level. Therefore, applying the lesson

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plans of the Pharmaceutical Management and Regulations course to the teaching of students in the Beijing Lianmi Education and Training Institute Certified Pharmaceutical Qualification Examination can improve students' academic achievements.

2.2 Instruments for collecting data

An instrument for measuring: Test paper of students' academic achievements and satisfaction questionnaire.

2.2.1 Test paper of students' academic achievements

The test consists of 30 items of multiple-choice questions, each of which has four alternatives with one correct answer. The test items consisted of four types of cognitive domains: 1) remember, 2) understand, 3) apply, and 4) analyze; The index of Item Objective Congruence (IOC) value of 30 items in the test paper was 0.80 at the lowest and 1.00 at the highest. The result of analyzing the IOC value showed that all test items were appropriate and could be used in the test. The test paper difficulty (p) was between 0.70-0.77, and item discriminability (r) should range from 0.56-0.88 and more than 0.20. The test paper reliability is 0.7218 and more than 0.7 (Richardson & Kuder, 1939: 681-687).

2.2.2 Satisfaction questionnaire (5-point Likert scale)

The questionnaire is provided to 5 experts for content validity check and suggestions. The quality of the questionnaire is considered according to the Index of Item Objective Congruence (IOC) obtained from the achievement test evaluation form. The IOC of each item of the satisfaction questionnaire was between 0.80-1.00. The result of analyzing the IOC index showed that 15 items in the satisfaction questionnaire were appropriate and could be used in the satisfaction evaluation of the Adaptive learning system. The Cronbach's Alpha coefficient of the reliability of the student satisfaction questionnaire is 0.721, which is greater than 0.70 (Cronbach, 1951). This showed that the internal consistency of the student satisfaction questionnaire met the requirements.

3. Data collection

The procedures of data collection were as follows: (1) The sample was given the pretest by measuring academic achievements with a pharmaceutical management and regulations knowledge test. (2) The samples were taught by using adaptive learning systems. (3) After finishing the instruction, the samples received the post-test by using the same instrument that was used in the pretest. (4) The samples were given the students' satisfaction questionnaire.

4. Data analysis

In this study, data were analyzed by using the statistical program according to the research objectives

4.1 Compare students' academic achievements before and after receiving adaptive learning systems by using t-tests for dependent samples.

4.2 Compare students' academic achievements with the determined criteria set at 70 percent by using a t-test for one sample.

4.3 Assess the student's satisfaction with adaptive learning systems by using arithmetic mean and standard deviation.

Research Results

The results were presented according to the research objectives as follows:

1. The result of comparing the different scores of academic achievements before and after learning through an adaptive learning system.

The result of comparing the different scores of academic achievements before and after learning

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through an adaptive learning system. The below table shows descriptive statistics and t-tests as analyzed by the statistical package program. This table aimed to answer the research objective about whether an adaptive learning system was able to enhance academic achievements.

Table 1 Paired sample test about academic achievements

Group	N	Pretest scores		Posttest scores		t	p
		M	S.D.	M	S.D.		
Experimental group	30	15.37	4.902	22.33	4.413	6.285*	0.000

*p＜0.05

As presented in Table 1, the mean score of the pretest of students' academic achievements was 15.37 (S.D. = 4.902) and the posttest of students' academic achievements was 22.33(S.D. =4.413). The result of this table showed that after learning through an adaptive learning system in the classroom, posttest scores of students' academic achievements were greater than pretest scores at.05 level of statistical significance (t_{29} = 6.285, $p=0.000$ <.05). The average scores of the study developed increasingly higher than pretest.

The results of the research objective of comparing the different scores of academic achievements after learning through an adaptive learning system with the criteria set at 70 percent.

The result of comparing the different scores of academic achievements after learning through an adaptive learning system with the criteria set at 70 percent. The below table shows descriptive statistics and t-tests as analyzed by the statistical package program. This table aimed to answer the research objective about whether an adaptive learning system was able to enhance academic achievements.

Table 2 The result of comparing the different scores of academic achievements after learning through an adaptive learning system with the criteria set at 70 percent.

Group	N	Full score	Criteria score	M	S.D.	t	p
Experimental group	30	30	21	22.33	4.413	27.722*	0.000

*p＜0.05

As presented in Table2, the mean scores of t students' academic achievements after learning through an adaptive learning system was 22.33 from possible full marks of 30 and the standard deviation was 4.413 which was statistically higher than the criterion of 70% at.05 level of statistical significance (t_{29}=27.722, $p=0.000$<.05). The above data indicates that learning management using an adaptive learning system can improve academic achievement among students.

To assess the students' satisfaction with the adaptive learning system.

The result of comparing the mean score of satisfaction after learning through an adaptive learning system. The below table shows descriptive statistics and t-tests as analyzed by the statistical package program. This table aimed to answer the research objective about whether using an adaptive learning system was able to enhance satisfaction.

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Table 3 Data analysis result of Students' satisfaction questionnaire

NO.		ITEM	M	S.D.	Level of appropriateness
Learning aspect	1	Learning management using an "adaptive learning system" helps achieve personalized learning	3.77	0.73	High
	2	Learning management using an "adaptive learning system" class, students can actively complete the tasks assigned by the teacher.	3.93	0.74	High
	3	Enjoy learning management using an "adaptive learning system" classroom atmosphere.	4.10	0.71	High
	4	Learning management using an "adaptive learning system", students can take the initiative to participate in group discussion activities.	3.97	0.89	High
Instructional strategy	5	Learning management using an "adaptive learning system" design meets student development levels	3.93	0.78	High
	6	Learning management using an "adaptive learning system" improves the ability to collaborate	4.03	0.85	High
	7	Learning management using an "adaptive learning system" combines new knowledge with previous knowledge.	4.00	0.79	High
Teaching efficiency	8	Learning Management Using "adaptive learning system" Improved learning efficiency	3.93	0.83	High
	9	Learning Management Using "adaptive learning system" Improves creativity	4.10	0.80	High
	10	Easy to achieve a sense of achievement after Learning Management Using an "adaptive learning system"	3.97	0.67	High
	11	Interest in learning increased after learning management using an "adaptive learning system"	4.07	0.74	High
Instructional evaluation	12	Learning management using an "adaptive learning system" improves practical skills.	4.10	0.76	High
	13	Learning management using an "adaptive learning system" Improves problem-solving skills.	4.23	0.77	High
	14	Learning management using an "adaptive learning system" Improves self-directed learning ability	3.97	0.85	High
	15	Learning management using "adaptive learning	4.13	0.78	High

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NO.	ITEM	M	S.D.	Level of appropriateness
	system" Improving academic achievements			
Overall Total		4.02	0.78	High

Based on the results, we can state the following: As shown in Table 3, the overall results of the adaptive learning system by experts are at a very high level with (M=4.02, S.D.= 0.78). Thus, it was concluded that students' satisfaction of the students after receiving an adaptive learning system was high.

Discussion

1. With the rapid development of technologies such as artificial intelligence, big data, and cloud computing, the integration of artificial intelligence and education has gradually entered the practical application level from the theoretical research level. An adaptive learning system is an educational technology system guided by a learner-centered education model, based on the characteristics and needs of individual learners, emphasizing the profound understanding and application of learning through intelligent technology and personalized algorithms, providing learners with customized learning paths, resources, and support. Meet the learning needs of different students, promote personalized teaching and learning, and improve the quality and efficiency of education and teaching. Promote self-directed learning, deep learning, and effective learning for learners. Li, G., The study by et al. (2020) suggests that adaptive learning systems can effectively reduce the workload of teachers in answering questions and tutoring after class, and accurately evaluate and intervene in students' weak knowledge points promptly, improving their interest, efficiency, and grades in self-directed learning.

In addition, adaptive learning has brought both opportunities and challenges to higher education. The basic properties of these adaptive systems allow students to immerse themselves in the content and learn materials at their own pace. Effective teaching curriculum design is a key factor, and goal and node granularity are key components of curriculum design. Adaptive learning is driven by a decision engine that requires prior information to determine the best learning path for students, and the high front-end load of creating courses can pay immeasurable dividends in the student's learning cycle (Dziuban, et al. 2018).

2. The reason why adaptive learning systems improve student satisfaction is that the system can collect student data and provide students with a learning experience that suits them based on student data. Through automated analysis and feedback, the system can understand students' weaknesses and learning needs, recommend the most effective learning resources, and enable students to master core concepts and skills more quickly. Hu & Chen (2018) research suggests that: 1) precise promotion of learning content, serving personalized learning; Maximizing the maintenance of one's learning interests and advantages, pursuing optimal learning outcomes. 2) Real-time feedback of learning information, optimizing teaching processes; Formative evaluation based on students' real-time learning situation stimulates and maintains learning motivation, and optimizes the learning process. 3) Collecting and analyzing learning data to facilitate teaching management; Promoting teaching management from a macro level to a micro level, committed to promoting the growth and progress of every student. The research results show that the above has a significant promoting effect on improving learning satisfaction.

In summary, the emergence and application of adaptive learning systems have significantly improved the learning experience of students. By studying the design and implementation of adaptive learning systems,

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we can better provide personalized education for students, improve learning efficiency and quality, and promote the deep integration of artificial intelligence technology and education.

Conclusion

By comparing and analyzing the pre - and post-test results of the "adaptive learning system" intervention in the Pharmaceutical Administration and Regulations course of registered pharmacist qualification exam students, the impact of the adaptive learning system on students is obtained. The conclusion is as follows: (1) The academic achievements of registered pharmacist qualification exam students using the "adaptive learning system" in the Pharmaceutical Administration and Regulations course were higher than those in the pre-test, and the difference was statistically significant (0.05). (2) After adopting the "adaptive learning system", the academic achievements of registered pharmacist qualification exam students in pharmaceutical administration and regulations courses were higher than the 70% standard, with a statistical significance of 0.05 (M=22.33, S.D.=4.413). (3) This study used SPSS software to evaluate the satisfaction of teaching through the adaptive learning system. The results indicate that students are highly satisfied with teaching through the adaptive learning system. Through adaptive learning system classroom practice, learning efficiency has been improved, and the personalized learning needs of students have been met. Helps to improve academic achievements among students and win their popularity.

Recommendation

Recommendation for implication

Based on the findings from the study, the following recommendations are made: (1) Set learning objectives: Before starting learning, set clear learning objectives. Adaptive learning systems can adjust learning content and progress based on students' goals. (2) Feedback mechanism: Ensure that the adaptive learning system has an effective feedback mechanism that can provide personalized learning feedback to learners promptly, helping them understand their learning progress and performance. (3) Personalized learning path: Ensure that the adaptive learning system can provide personalized learning paths and resources based on the learning needs and performance of learners, to meet their needs to the greatest extent possible.

Recommendation for further research

With the development of artificial intelligence and machine learning, the application of adaptive learning systems in the field of education is becoming increasingly widespread. In the future, there are several research prospects in the following areas: (1) Personalized learning models: Currently, adaptive learning systems mainly rely on statistical models and rule engines for personalized adjustments. Future research can explore more refined and accurate personalized learning models, such as combining deep learning and reinforcement learning methods, to better understand the characteristics and needs of learners. (2) Interdisciplinary research: Adaptive learning systems involve multiple disciplinary fields, including education, psychology, computer science, and more. Future research can further promote cooperation and communication among different scientific fields, to promote the development and application of adaptive learning systems.

References

Brusilovsky, P. (1996). Methods and techniques of adaptive hypermedia. *User Modeling and User-Adapted Interaction,* 6(3), 87-129.

Citation
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Chen, J. (2021). *Master's thesis on the construction and system design of an adaptive learning framework for online education*. Northeastern Normal University. Retrieved from: https://link.cnki.net/doi/10.27011/d.cnki.gdbsu.2021.000260doi:10.27011/d.cnki.gdbsu.2021.000260.

CQLP. (2023) *Certification Center for licensed Pharmacists of NMPA Test trends*. Retrieved from: http://www.cqlp.org/info/infoxlb.aspx?page=1&infox=1000310001.

Cronbach, L.J. (1951). Coefficient Alpha and the Internal Structure of Tests. Psychometrika, 16, 297-334. https://doi.org/10.1007/BF02310555

De Bra, P., Houben, G-J., & Wu, H. (1999). AHAM: a Dexter-based reference model for adaptive hypermedia. *In Proceedings of the tenth ACM Conference on Hypertext and hypermedia*: returning to our diverse roots: returning to our diverse roots (pp. 147-156). https://doi.org/10.1145/294469.294508

Dziuban, C., Howlin, C., Moskal, P., Johnson, C., Parker, L., & Campbell, M. (2018). Adaptive Learning: A Stabilizing Influence Across Disciplines and Universities. *Online Learning.* 22 (3). Doi: 10.24059/olj.v22i3.1465.

Hu, W., & Chen, Y. (2018). Adaptive Learning: A New Push for Personalized Learning in the Era of Big Data. *China's Education Informatization,* 21, 42-47 Doi: CNKI:SUN:JYXX.0.2018-21-011

Li, G., et al. (2020). Application Research of Adaptive Learning Systems in English Learning for Adult Undergraduate Bachelor's Degree. *Modern Educational Technology*, 3, 59-65

Li, Z., et al. (2018). Research on Educational Artificial Intelligence in the Context of Artificial Intelligence Applications. *Modern Educational Technology*, 9, 19-25

Ministry of Education of China. (2018). Notice of the Ministry of Education on Issuing the Action Plan for Artificial Intelligence Innovation in Higher Education Institutions. Ministry of Education of the People's Republic of China. http://www.moe.gov.cn/srcsite/A16/s7062/201804/t20180410_332722.html

National Medical Products Administration. (2020). *Notice of the State Food and Drug Administration on Regulating the Use of Licensed Pharmacists in Drug Retail Enterprises.* Chinese government portal. Retrieved from: https://www.gov.cn/zhengce/zhengceku/2020-11/21/content_5563176.htm

Richardson, M.W., & Kuder, G.F. (1939). The calculation of test reliability coefficients based on the method of rational equivalence. *Journal of Educational Psychology, 30*(9), 681–687. https://doi.org/10.1037/h0054933

Somyurek, S. (2015). The New Trends in Adaptive Educational Hypermedia Systems. *International Review of Research in Open & Distributed Learning*, 16(1), 221-241.

State Council of China. (2017). *Notice of the State Council on Issuing the Development Plan for the New Generation of Artificial Intelligence*. Chinese government portal. Retrieved from:https://www.gov.cn/zhengce/zhengceku/2017-07/20/content_5211996.htm

Ye, X. (2019). *Research on the Knewton Adaptive Learning Platform in the United States.* Master's Thesis, Southwest University https://kns.cnki.net/KCMS/detail/detail.aspx?dbname=CMFD201902&filename=1019913792.nh

Zhou, Q., & Wen, X. (2020). From Adaptation to Intelligent Adaptation: A New Path to Personalized Learning in the Age of Artificial Intelligence. *Modern Education Management,* 9, 89-96. doi: 10.16697/j.1674-5485.2020.09.012

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