INTENTION TO USE BIG DATA TECHNOLOGY IN TEACHING AMONG HIGHER EDUCATION EDUCATORS IN YUNNAN, CHINA

By

WANG QIANHUI

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia,in Fulfilment of the Requirements for the Degree of Master of Science

July 2022

FPP 2022 52

COPYRIGHT

Abstract of thesis presented to the Senate of University Putra Malaysia in fulfilment of the requirements for the degree of Master of Science

INTENTION TO USE BIG DATA TECHNOLOGY IN TEACHING AMONG HIGHER EDUCATION EDUCATORS IN YUNNAN, CHINA

By

WANG QIANHUI

July 2022

Chairman : Associate Professor Habibah binti Ab Jalil, PhD
Faculty : Educational Studies

Big data technology has brought a huge impact to the education field. Personalized learning analysis and intelligent decision support based on accurate learning diagnoses made possible with big data have greatly improved the quality of education, optimized educational management, and become vital support for realizing education modernization. However, there are still problems in teachers' use of big data technology in teaching practice, and there is a lack of in-depth theoretical analysis and practical research on exploring the factors influencing teachers' behavioural intentions to use big data technology in teaching. Therefore, the purpose of this study is to explore the factors influencing behavioural intention to use big data technologies in teaching among higher education educators in Yunnan based mainly on the UTAUT model and to investigate the main challenges currently perceived by higher education teachers in the field of big data in education.

This quantitative correlational study involved 193 higher education educators in Kunming, Yunnan Province, selected through simple random sampling. The survey questionnaire used in this study was adapted from past related studies. Its content validity was evaluated and confirmed by experts, and it was shown to have good structural validity through exploratory and confirmatory factor analyses. The reliability values of the instrument ranged from 0.887 to 0.904. The study used IBM SPSS version 25.0 to analyse the data.

The results of the independent samples *t*-test showed that there were no significant differences in the behavioural intention of higher education educators to adopt big data technology in teaching based on gender. The results of the one-way ANOVA showed that there were no significant differences in the behavioural intentions of educators to adopt big data technology in teaching based on both age and teaching experience. In the correlation analysis, except for effort expectation (r (193) =0.134, p=0.063 >0.05),

which was not significantly related to intention to use big data technology in teaching, performance expectation, social influence, and facilitating conditions all had significant relationships with the intention to use.

The results of the multiple linear regression indicated that the combination of the four independent variables contributed significantly (39%; $R^2 = 0.357$) to educators' intention to use big data technology, which implies that the four studied variables predicted the dependent variable. Performance expectancy ($\beta = 0.415$, $p = 0.000$) was found to be the most significant factor contributing to educators' intention to use big data technology. Therefore, universities should focus on increasing educators' awareness of the benefits as well as the outcomes of using big data technologies in teaching to encourage more educators to adopt big data technology in teaching. However, it is noteworthy that after controlling for other variables, effort expectancy and social influence became insignificant predictors. In addition, the survey revealed that the biggest obstacle to big data in education is the expensive cost.

In summary, this study contributes to the knowledge of big data technology and has major implications for educators' practice of big data technology. On the one hand, the predictive model obtained from this study is likely to be useful as a reference for future research in related fields. On the other hand, based on the factors that influence educators' intentions to use big data technology in teaching and the main barriers that big data mainly faces in the field of education, the study provides recommendations for university administrators and policy makers to motivate educators' intentions to use big data technology in teaching so that intentions can eventually be turned into actual usage behaviours.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

NIAT DAN UNTUK MENGGUNAKAN TEKNOLOGI DATA RAYA DALAM PENGAJARAN DALAM KALANGAN GURU DI INSTITUSI PENDIDIKAN TINGGI DI YUNNAN, CHINA

Oleh

WANG QIANHUI

Julai 2022

Pengerusi : Profesor Madya Habibah binti Ab Jalil, PhD
Fakulti : Pengajian Pendidikan

Teknologi data raya telah membawa impak yang besar kepada bidang pendidikan. Analisis pembelajaran yang diperibadikan dan sokongan keputusan pintar berasaskan diagnosis pembelajaran yang tepat dengan adanya data raya telah meningkatkan kualiti pendidikan, pengurusan pendidikan yang optimum dan menjadi sokongan penting untuk merealisasikan pendidikan moden. Walau bagaimanapun, masih terdapat masalah penggunaan teknologi data raya dalam kalangan guru dalam amalan pengajaran, dan terdapat kekurangan analisis teoritikal dan penyelidikan praktikal yang mendalam untuk meneroka faktor yang mempengaruhi niat tingkah laku guru untuk menggunakan teknologi data raya dalam pengajaran. Oleh itu, tujuan kajian ini adalah untuk meneroka faktor yang mempengaruhi niat tingkah laku untuk menggunakan teknologi data raya dalam pengajaran dalam kalangan pendidik pendidikan tinggi di Yunnan berdasarkan model UTAUT dan untuk menyiasat cabaran utama yang dihadapi pada masa ini oleh guru pendidikan tinggi dalam bidang data raya dalam pendidikan.

Kajian kuantitatif dan korelasi ini melibatkan 193 pendidik pendidikan tinggi di Kunming, Wilayah Yunnan yang dipilih melalui persampelan rawak mudah. Tinjauan melalui soal selidik yang digunakan diadaptasi daripada kajian-kajian lepas yang berkaitan. Kesahan kandungannya dinilai dan disahkan oleh pakar, dan ia terbukti mempunyai kesahan struktur yang baik melalui penerokaan dan pengesahan analisis faktor. Nilai kebolehpercayaan instrumen adalah antara 0.887 hingga 0.904. Kajian menggunakan IBM SPSS versi 25.0 untuk menganalisis data.

Keputusan ujian-t sampel bebas menunjukkan tidak terdapat perbezaan yang signifikan dalam niat tingkah laku pendidik pendidikan tinggi untuk mengguna pakai teknologi data raya dalam pengajaran berdasarkan jantina. Keputusan ANOVA sehala menunjukkan tidak terdapat perbezaan yang signifikan dalam niat tingkah laku pendidik untuk

mengguna pakai teknologi data raya dalam pengajaran berdasarkan kedua-dua factor umur dan pengalaman mengajar. Dalam analisis korelasi, kecuali dalam jangkaan usaha (r (193) =0.134, p=0.063 >0.05), dimana tiada hubungan yang signifikan dengan niat untuk menggunakan teknologi data raya dalam pengajaran, jangkaan prestasi, pengaruh sosial, dan keadaan pemudah cara semuanya mempunyai hubungan yang signifikan dengan niat untuk digunakan.

Keputusan regresi linear berganda menunjukkan bahawa gabungan empat pembolehubah tidak bersandar menyumbang secara signifikan (39%; $R^2 = 0.357$) kepada niat pendidik untuk menggunakan teknologi data raya, yang membayangkan bahawa empat pembolehubah yang dikaji meramalkan pembolehubah bersandar. Jangkaan prestasi (β = 0.415, p = 0.000) didapati merupakan faktor paling signifikan yang menyumbang kepada hasrat pendidik untuk menggunakan teknologi data raya. Oleh itu, universiti harus memberi tumpuan kepada meningkatkan kesedaran pendidik tentang faedah serta hasil penggunaan teknologi data raya dalam pengajaran untuk menggalakkan lebih ramai pendidik mengguna pakai teknologi data raya dalam pengajaran. Walau bagaimanapun, perlu diperhatikan bahawa selepas mengawal pembolehubah lain, jangkaan usaha dan pengaruh sosial menjadi peramal yang tidak penting. Di samping itu, tinjauan ini mendedahkan bahawa halangan terbesar kepada data raya dalam pendidikan ialah kos yang mahal.

Secara ringkasnya, kajian ini menyumbang kepada pengetahuan teknologi data raya dan mempunyai implikasi besar terhadap amalan teknologi data raya pendidikan. Di satu pihak, model ramalan yang diperoleh daripada kajian ini berkemungkinan berguna sebagai rujukan untuk penyelidikan masa depan dalam bidang berkaitan. Sebaliknya, berdasarkan faktor yang mempengaruhi niat pendidik untuk menggunakan teknologi data raya dalam pengajaran dan halangan utama yang dihadapi oleh data raya terutamanya dalam bidang pendidikan, kajian ini memberikan cadangan kepada pentadbir universiti dan pembuat dasar untuk memotivasikan pendidik, niat untuk menggunakan teknologi data raya dalam pengajaran supaya niat akhirnya boleh diubah menjadi tingkah laku penggunaan sebenar.

ACKNOWLEDGEMENTS

Alhamdulillah, praise to Allah subhanallahita'ala. On the occasion of completing my thesis, I would like to express my sincere gratitude to my supervisor, co- supervisor, my classmates, my friends, and my family who have supported and guided me. Without their help, this thesis would not be materialized.

First and foremost, I would like to take this opportunity to express my sincere heartfelt gratitude to my supervisor, Associate Professor Dr. Habibah Binti Ab Jalil. During my graduate studies, Professor Habibah has guided me in choosing the direction of my research topic, helping me in the process of my research, revising my thesis, etc., and caring for me in my daily life that enabled me to have a clear goal in my graduate studies and life and to complete my studies successfully. Meanwhile, I have been deeply influenced by her easy-going personality and disciplined attitude to her studies. I would also like to express my gratitude to my research committee member, Dr. Aini Marina Ma'rof, for her comments and suggestions on this thesis. Thank you for taking time out of your schedule to serve on my committee although you have many other commitments.

I am very grateful to the lecturers, students, and staff of the UPM School of Educational Studies, who not only helped me a lot during my studies but also shared a lot of useful knowledge and constantly motivated me to complete my master's thesis.

Finally, I would like to thank my family, as their care, support and encouragement have enabled me to complete my master's study and set a solid foundation for my future study, life, and work.

This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfillment of the requirement for the degree of Master of Science. The members of the Supervisory Committee were as follows:

Habibah binti Ab Jalil, PhD
Associate Professor
Faculty of Educational Studies
Universiti Putra Malaysia
(Chairman)

Aini Marina Ma'rof, PhD
Senior Lecturer
Faculty of Educational Studies
Universiti Putra Malaysia
(Member)

ZALILAH MOHD SHARIFF, PhD
Professor and Dean
School of Graduate Studies
Universiti Putra Malaysia

Date: 9 February 2023

Declaration by graduate student

I hereby confirm that:

- this thesis is my original work;
- quotations, illustrations and citations have been duly referenced;
- this thesis has not been submitted previously or concurrently for any other degree at any institutions;
- intellectual property from the thesis and copyright of thesis are fully-owned by Universiti Putra Malaysia, as according to the Universiti Putra Malaysia (Research) Rules 2012;
- written permission must be obtained from supervisor and the office of Deputy Vice-Chancellor (Research and innovation) before thesis is published (in the form of written, printed or in electronic form) including books, journals, modules, proceedings, popular writings, seminar papers, manuscripts, posters, reports, lecture notes, learning modules or any other materials as stated in the Universiti Putra Malaysia (Research) Rules 2012;
- there is no plagiarism or data falsification/fabrication in the thesis, and scholarly integrity is upheld as according to the Universiti Putra Malaysia (Graduate Studies) Rules 2003 (Revision 2012-2013) and the Universiti Putra Malaysia (Research) Rules 2012. The thesis has undergone plagiarism detection software

Signature: _____ Date: _____

Name and Matric No: Wang Qianhui

Declaration by Members of Supervisory Committee

This is to confirm that:

- the research conducted and the writing of this thesis was under our supervision;
- supervision responsibilities as stated in the Universiti Putra Malaysia (Graduate Studies) Rules 2003 (Revision 2012-2013) are adhered to.

Signature: _____

Name of Chairman of Supervisory Committee: Associate Professor Dr. Habibah binti Ab Jalil

Signature: _____

Name of Member of Supervisory Committee: Dr. Aini Marina Ma'rof

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

AMOS	Analysis of Moment Structure
AVE	Average Extracted Variance
BI	Behavioural Intention
CFA	Confirmatory Factor Analysis
CFI	Comparative Fit Index
CR	Combined Reliability
EDA	Exploratory Data Analysis
EDM	Educational Data Mining
EE	Effort Expectancy
EFA	Exploratory Factor Analysis
FC	Facilitating Conditions
GFI	Goodness of Fit Index
ICT	Information and Communications Technology
IFI	Incremental Fit Index
LA	Learning Analytics
LAK	Learning Analytics & Knowledge
MOOC	Massive Open Online Courses
NFI	Normed Fit Index
P	Level of Significant
PCA	Principal Component Analysis
PE	Performance Expectancy
RMSEA	Root Mean Square Error of Approximation
SI	Social Influence
SPOC	Small Private Online Course
SPSS	Statistical Package for Social Science

TAM	Technology Acceptance Model
TAM2	Technology Acceptance Extension Model
TF	Tolerance Factor
TLI	Tucker Lewis Index
TPB	Theory of Planned Behavior
TRA	Theory of Reasoned Action
UPM	Universiti Putra Malaysia
UTAUT	The Unified Theory of Acceptance and Use of Technology
VIF	Variance Inflation Factor
χ 2/df	Chi Square/Degrees of Freedom

CHAPTER 1

INTRODUCTION

1.1 Introduction

The world is currently experiencing rapid advancement in internet technologies such as cloud computing and big data, which are becoming increasingly pervasive in the social and economic spheres of life, changing people's behavioural habits and thinking patterns. The advent of the big data era foreshadows a new technological revolution. Almost all sectors of society have felt big data's wave of influence, and the education field is no exception. The gradual expansion of big data into the education field has triggered reforms and innovations, including education management decision-making innovations, which have strongly encouraged the transformation of education and teaching from traditional empirical decision-making to new data-driven decision-making and greatly incentivised the education field to become data smart (Ru, 2022).

In March 2012, the US government implemented the "Big Data Research and Development Plan," asserting that "Big Data" is "the oil of the future" (Liu, 2022). The plan was meant to achieve the purpose of strengthening homeland security by reforming the educational learning model, accelerating the speed of innovation in the scientific fields, and improving the level of quality in the engineering field, thus bringing profound influence to the future development of science and education (Liu, 2022). In 2015, the State Council of China's "Outline of Action to Promote the Development of Big Data" emphasized exploring the impact of big data with regard to supporting educational changes, improving the quality of education, and promoting educational equity (State Council of China, 2015). On November 17–18, 2018, the 17th International Forum on Educational Technology was successfully held in Central China Normal University, China. Its theme was "Big Data and Educational Intelligence." The conference promoted learning analysis based on big data as an intelligent new educational method (Zhuo et al., 2019). From August 1–2, 2019, the "Big Data Summit on Artificial Intelligence and Education" was held at the National Convention Centre in Beijing, China. The summit was convened to discuss the in-depth application of artificial intelligence, big data, and other technologies in education and accelerated reform of the talent training and educational governance modes in the education sector. The summit emphasised big data technology as a means for talent educators to utilise intelligent teaching to drive personal development. These events have evidently taken place in response to the world's present interest in the application of big data in education as a means to achieve advancements in the modern education industry and as an essential measure to optimize education management and decision-making (Li, 2019).

Since the reform of economics and opening-up of policy in China, Yunnan Province has adhered to the path of development in line this new reality. In less than 20 years, Yunnan Province has become a rapidly developing province in the west (People's Government of Yunnan Province, 2021). In 2016, Yunnan's big data educational development and application centre was established. The Yunnan Provincial Department of Education and the China Mobile Yunnan telecommunications company signed a strategic cooperation

agreement on educational informatization in Yunnan Province. They formed this alliance for the development and application of big data in education and subsequently began steadily promoting educational informatization in Yunnan Province, which led to building the "Internet + Education" demonstration zone (The Yunnan Network of ICT in Education, 2016). In 2017, Yunnan Province supported educators' lesson preparation and student preview services on their cloud platform, synchronized interactive classes across geographical limits, and enabled children's education in remote and poor areas. They were able to receive lectures from excellent educators and experience the improvements made to the applications of the Public Service Platform of Educational Resources and Education Management (The Yunnan Network of ICT in Education, 2018).

In 2018, the Yunnan Educational Equipment Exhibition and Educational Informatization Forum was held in the provincial university centre. By September 30, 2018, Yunnan Telecom's Education Optical Network Project, a key project to build cloud network integration, had covered 90% of schools in Yunnan Province, providing a reliable, advanced, high-capacity, and high-quality basic network for realizing smart education in Yunnan Province (China (Kunming) South Asia Social Public Security Technology Exposition, 2018). In 2019, the educational informatization work conference of Yunnan Province was held in Cangyuan. The premise of "Yunnan Education Modernization 2035" was that Yunnan Province should firmly seize the opportunity of digital Yunnan construction, and the provincial education system should integrate information technology such as big data and artificial intelligence into the education process, build a new way of educating students, and innovate new forms of education service (Yunnan Province Education Department, 2019). Due to the explosion of COVID-19 in early 2020, all face-to-face education has been delayed and approximately 38 million higher education students have had to learn using online resources, mainly massive open online courses (MOOCs) and small online courses (SPOCs). It can be argued that this epidemic has facilitated the use of big data technology in higher education. Complex models can be built using big data technology to analyse data such as learning behaviours, assess learning effectiveness, and diagnose problems in a timely manner (Tian & Zheng, 2017). Educators can effectively identify students' weaknesses and strengths and make adjustments to the curriculum and further improve student performance with the help of big data technology. However, big data technology is still underutilized in the field of education in Yunnan Province (Zhang et al., 2020). Therefore, this study aims to examine the factors which affect the intention to use big data technology among higher education educators in Yunnan.

The unified theory of acceptance and use of technology (UTAUT) combines multiple theories such as planned behaviour theory and multiple models such as the technology acceptance model to explore factors affecting user adoption of new technologies (Venkatesh et al., 2003). Venkatesh et al. (2003) proposed the following four main independent variables for inclusion into the UTAUT model: performance expectancy, effort expectancy, social influence, and facilitating conditions. These are factors that affect user intentions to use technology and their usage behaviour. They are moderated by gender, age, experience, and voluntariness. Many previous studies have already found potential effects of these variables on the acceptance of new technologies (Venkatesh et al., 2003; Kay, 2006; Lau & Sim, 2008), while others have not found any potential effects of these variables (Oye et al., 2011; Al-Shawi & Al-Wabil, 2013; Alkhasawneh &

Alanazy, 2015). Therefore, the researcher examined statistical differences in higher education educators' intentions to use big data technology in teaching based on their age, gender, and experience. Currently, UTAUT is considered to be a powerful predictive model for technology use, and as a result, many researchers have used, validated, and extended the model (Gupta et al., 2008; Yoo et al., 2012).

1.2 Problem Statement

Compared to traditional teaching, the use of big data technology in teaching can achieve the goals of personalized education, improving teaching effectiveness, optimizing the teaching process, and improving teaching evaluation (Drigas & Leliopoulos, 2014). West (2012) argued that "big data make it possible to mine learning information for insights regarding student performance and learning approaches. Rather than rely on periodic test performance, instructors can analyse what students know and what techniques are most effective for each pupil" (p. 1). Sun (2021) claimed that the gradual integration of big data into the education field has significantly influenced the initiation of reforms and innovations, including developments in education management decision-making, which have significantly enhanced the transformation of education and teaching from traditional empirical decision-making to new data-driven decision-making and advanced the education field to become more data-smart. China's Education Modernization 2035 plan states that education reform in the information age should be accelerated and an integrated intelligent teaching, management and service platform should be planned and built in a coordinated manner (Zhou, 2019). Colleges and universities mainly use information technology to realize the collection, storage, integration and sharing of education and teaching data, realize the timeliness, convenience and authenticity of education effect feedback with the help of the platform, and promote the accuracy, science and rationality of education decision-making through data integration and analysis (Allen et al., 2021). In addition, universities should use modern technology to cultivate talent. Therefore, digital education resource sharing should be established and enhanced between colleges and universities (Zhou, 2019). The potential role of big data technology in education can lead to better learning outcomes. Therefore, the State Council of China has been encouraging all universities to adopt big data technologies in their teaching practices to achieve better results.

However, while big data provides opportunities for education, it also presents various challenges (Hanapiyah et al., 2018). Since the application of big data in education in China is still in its early stages of development (Zhang et al., 2020), educators in higher education lack awareness and comprehension of big data technologies in teaching, and they tend to use it incorrectly and insufficiently. For Yunnan Province, although big data has achieved some success in information education, it is still in its infancy and immature, with gaps in ideological understanding, low application levels, and uneven promotion of network security awareness and capabilities (Zhou, 2019). Some college and university administrators and personnel do not understand education informatization in the context of the overall educational situation and teaching needs and are still stuck in the old thinking that "informatization is to allocate a few computers and make some courseware" (Zhou, 2019). Faced with the advent of the big data era, teachers still rely on prior experience to make teaching decisions, which leads to an inability to fully grasp the changes taking place in learning conditions and the associated challenges of teaching

and learning, thus making it difficult for teachers to effectively manage the teaching of their subjects (Shi & Wu, 2022).

The reality of adopting big data technology in Chinese higher education has also encountered a number of barriers related to infrastructure, faculty training programs, institutional policies, technical support, and attitudes toward the use of technology in education. Multiple parties in higher education in Yunnan Province collect data, resulting in data conflicts, and data are not yet available to support educational teaching and learning decisions. Furthermore, the mechanism of dynamic management and declaration and verification of education data is not robust (Zhou, 2019). The lack of information infrastructure construction in Yunnan universities and the lack of multimedia teaching equipment in weak schools (Tian & Zheng, 2017) have led to the difficult task of digital transformation in education. In addition, teachers in Yunnan Province are basically able to apply technology, but the ability to innovate in information technology teaching is still insufficient, and the depth of technology integration in subject teaching is not adequate (Zhou, 2019). As a result, it is impossible to build a mechanism for the common construction and sharing of digital education resources to realize the organic combination of large-scale education and personalized training. As a frontier province, higher education in Yunnan Province suffers from low efficiency, high costs and low levels of achievement. To improve the level and quality of education and eliminate information silos, smart education is the best choice for Yunnan, and big data technology is the smart choice as a foundation for the construction of a smart education system (Tian & Zheng, 2017).

All these issues, in fact, inhibit learning outcomes. Therefore, it is essential to study the concept of technology integration in higher education in Yunnan Province, China, to highlight the factors that influence educators' intentions to use big data technology in teaching. Based on the results of this quantitative study, the researcher provides a suggested solution for higher education institutions in Yunnan Province to address each of the influencing factors that hinder the adoption of big data technology by educators.

It is important to note that research on the educational uses of big data in China currently focuses on basic theories concerning its concepts and characteristics such as its application value and prospects, opportunities, challenges. applications and the innovations supported by the technology. There is particular interest in ideological and political education for undergraduate students (Jiang et al., 2019), but this does not involve the intention of using big data technology in practice. Furthermore, previous big data research has primarily focused on technical attributes such as machine learning or technical algorithms with little consideration given to the intention to use big data technology in practice (Kwon et al., 2019). In addition, although a few studies have focused on intentions to adopt big data technology in organizations, mainly including the public sector and companies (Brünink, 2016; Demoulin & Coussement, 2020; Verma et al., 2018; Sahid et al., 2021; Akintola, 2019; Queiroz & Pereira, 2019; Cabrera-Sánchez & Villarejo-Ramos, 2019), identifying the factors that influence educators' intentions to use big data technology in teaching needs more research.

The previous studies which have focused on intentions to adopt big data technology mainly used the Unified Theory of Acceptance and Use of Technology (UTAUT) model and Technology Acceptance Model (TAM). The UTAUT model has a much higher ability to explain 70% of technology use intentions compared to TAM. Brünink (2016) also found that before the initial deployment of big data technology, decision makers can assess an organization's level of acceptability by using the UTAUT model, which is well suited to the context of big data technology. Therefore, this research sought to determine which factors impacting the intention to use big data technology in teaching among higher education instructors in Yunnan based on UTAUT model. This study also sought to provide a reference for universities and colleges on adopting big data technology to help colleges better prepare for its adoption and encourage the growth of big data education in colleges and universities. Furthermore, this study sought to determine whether gender, age, and teaching experience influence educators' acceptance of big data technologies in Yunnan Province.

1.3 Objectives

This research explored factors that influence the intention of using big data technology among educators in Yunnan higher education. The research used the unified theory of acceptance and use of technology (UTAUT) to examine these factors because UTAUT can be used to efficiently determine the factors that predict the intention to use new technology and the behaviour of users of new technology. While exploring these factors, the research considered the current challenges of big data in education for the development of suggestions on adoption of the technology and its effective integration into education by universities and colleges. Specifically, the research objectives were as follows:

1. To describe the types of big data applications used in teaching among higher education educators in Yunnan.
2. To describe the level of performance expectancy, effort expectancy, social influence, facilitating conditions, and intention to use big data technology in teaching among higher education educators in Yunnan.
3. To examine if there are statistical differences in higher education educators' intentions to use big data technology in teaching based on their age, gender, and experience.
4. To examine the relationship between independent variables (performance expectancy, effort expectancy, social influence and facilitating conditions) and the dependent variable (behavioural intention to use big data technology in teaching).

Concerning the fourth objective, there were four sub-objectives:

a) To examine the relationship between performance expectancy towards behavioural intention to use big data technology in teaching among higher education educators in Yunnan.

b) To examine the relationship between effort expectancy towards behavioural

intention to use big data technology in teaching among higher education educators in Yunnan.

c) To examine the relationship between social influence towards behavioural intention to use big data technology in teaching among higher education educators in Yunnan.

d) To examine the relationship between facilitating conditions towards behavioural intention to use big data technology in teaching among higher education educators in Yunnan.

5. To investigate the factors contributing to the behavioural intention to use big data technology in teaching among higher education educators in Yunnan.
6. To investigate the main challenges of big data in education.

1.4 Research Questions and Hypotheses

This study used quantitative methods to explore the factors influencing the intention of educators to use big data at Yunnan University. Based on the unified theory of acceptance and use of technology (UTAUT), four main independent variables were investigated: performance expectancy (PE), effort expectancy (EE), social influence (SI), and facilitating conditions (FC). These four factors helped determine whether the college and university educators could accept the use of big data technology, meaning that they had the intention to use the technology. In addition, variables such as age, experience, and gender were investigated to determine their impacts on the results. According to the above objectives, the study investigated the following research questions:

1. What are the types of big data applications used in teaching among higher education educators in Yunnan?
2. What is the level of performance expectancy among higher education educators in Yunnan?
3. What is the level of effort expectancy among higher education educators in Yunnan?
4. What is the level of social influence among higher education educators in Yunnan?
5. What is the level of facilitating conditions among higher education educators in Yunnan?
6. What is the level of intention to use big data technology in teaching among higher education educators in Yunnan?
7. Are there statistical differences in higher education educators' intentions to use big data technology in teaching based on their age, gender, and experience?
8. What is the relationship between the independent variables and behavioural intention?

9. How do performance expectancy, effort expectancy, social influence, and facilitating conditions affect intention to use big data technology in teaching among higher education educators in Yunnan?

10. What are the main challenges of big data in education?

Based on the seventh to the ninth research questions, the following hypotheses were proposed:

H1o: There is no statistically significant difference in intention to use big data technology in teaching among higher education educators in Yunnan based on gender.

H1a: There is a statistically significant difference in intention to use big data technology in teaching among higher education educators in Yunnan based on gender.

H2o: There is no statistically significant difference in intention to use big data technology in teaching among higher education educators in Yunnan based on age.

H2a: There is a statistically significant difference in intention to use big data technology in teaching among higher education educators in Yunnan based on age.

H3o: There is no statistically significant difference in intention to use big data technology in teaching among higher education educators in Yunnan based on experience.

H3a: There is a statistically significant difference in intention to use big data technology in teaching among higher education educators in Yunnan based on experience.

H4o: There is no significant relationship between performance expectancy and intention to use big data technology in teaching among higher education educators in Yunnan.

H4a: There is a significant relationship between performance expectancy and intention to use big data technology in teaching among higher education educators in Yunnan.

H5o: There is no significant relationship between effort expectancy and intention to use big data technology in teaching among higher education educators in Yunnan.

H5a: There is a significant relationship between effort expectancy and intention to use big data technology in teaching among higher education educators in Yunnan.

H6o: There is no significant relationship between social influence and intention to use big data technology in teaching among higher education educators in Yunnan.

H6a: There is a significant relationship between social influence and intention to use big data technology in teaching among higher education educators in

Yunnan.

H7o: There is no significant relationship between facilitating conditions and intention to use big data technology in teaching among higher education educators in Yunnan.

H7a: There is a significant relationship between facilitating conditions and intention to use big data technology in teaching among higher education educators in Yunnan.

H8o: Performance expectancy, effort expectancy, social influence, and facilitating conditions do not predict intention to use big data technology in teaching among higher education educators in Yunnan.

H8a: Performance expectancy, effort expectancy, social influence, and facilitating conditions predict intention to use big data technology in teaching among higher education educators in Yunnan.

1.5 Significance of Study

So far, few scholars have combed and empirically analysed the influencing factors that affect the intention of high education educators to adopt big data technology. With the advancement of the information age, the application of big data in education is also increasing, which has boosted educational innovation and development. To better integrate big data into higher education and serve higher education better, it is necessary to carry out an in-depth discussion on this. The purpose of this study was to deeply study the factors influencing the intention of university and college educators to adopt big data technology and to discuss the challenges faced by big data when it is applied to education. This study has important theoretical research value and practical significance.

From the perspective of users, this thesis explores the main influencing factors of the intention of educators to use big data technology in higher education, fills existing research gaps in the field of big data, and is of great significance for the theoretical research content of big data technology adoption in universities. Furthermore, based on the results from analyses of the study's survey questionnaire data, the acceptance of big data technology can be better understood. Through this empirical research, the main factors affecting the acceptance of big data technology by educators in higher education were determined and analysed to reach conclusions useful in providing guidance on the use of big data in colleges and universities to help promote the development of big data in the field of education.

1.6 Limitation of Study

The study required a significant amount of time to accomplish the requisite theoretical research, model selection, questionnaire design, and data analysis while striving to be rigorous and innovative. However, due to the limitations of research time and personal ability, there were still some shortcomings.

First, this study was limited by sampling. Because the research scope was limited to university educators and the data collection was restricted by the requirement that the participation of employees be on a voluntary basis, the number of valid samples was relatively small in the end. This may have weakened the representativeness of the sampled group of participants, affecting the accuracy of data analysis. Therefore, whether the research conclusions can be extended to other regions and other schools needs further verification.

The second limitation was the research method. This research mainly adopted the questionnaire survey method to collect research data. When filling out the questionnaire, the respondents could have been affected by many factors, such as emotions, time constraints, or lack of understanding of the meaning of the questions. Authenticity and reliability were thus difficult to control. Although the author conducted a long-term screening after the questionnaires were collected, there were still many questionnaires that were not answered carefully, which could have made the results of the study biased. Furthermore, the inability of positivism to explain how social reality is formed and maintained and how people explain their behaviour and that of others is a limitation of quantitative research (Blaikie, 2007). In this study, because the researcher did not interview educators, it was not possible to gain insight into why their levels of use and attitudes toward big data technology were the way they were. It is thus recommended to use a combination of qualitative and quantitative methods in subsequent studies, which complement each other to improve the accuracy and reliability of the results.

1.7 Definition of Terms

To provide a clear understanding of the research context, some key definitions of terms relevant to the study are provided below:

Big Data

Big data is a high-volume, high-variety, and high-speed data set that requires new forms of processing for analyses to support and enhance decision-making mechanisms and optimize processes (Beyer & Laney, 2012). It is defined by the four dimensions of volume, diversity, accuracy, and speed (Mayer-Schönberger & Cukier, 2013).

Big Data Technology

Big data technology is a collective term for software tools created to extract, process, and analyse data from enormously complex big data sets that could not be handled by traditional data processing software (Osakwe et al., 2020). For this study, big data technology mainly refers to the educators' use of learning analytics and educational data mining technology to analyse massive amounts of data (e.g., behavioural data recording the learning process, evaluation data recording the learning results, etc.) generated on online education platforms (e.g., China University MOOC) to further understand the student learning process and predict student performance. Based on the analysis results of big data technology, educators can adjust and optimize teaching methods, and effectively intervene and personalize education for students.

Higher Education

Higher education is a type of professional talent education based on secondary education. It is a social activity aimed at training specialized talents. It has basic education functions and social functions, of which the core function is education (Zhang, 2000). For this study, higher education included academies, universities, and colleges.

Factor

A factor is a component that contributes to effects or achievements (Cleveland-Marwick, 2015). For this study, factors refer to a combination of various elements that affect the intention of college and university educators to adopt big data technology.

Performance Expectancy

Performance expectancy is the degree to which users perceive that new technology can help them work more efficiently (Venkatesh et al., 2003). For this study, the performance expectancy is inseparable from the belief of educators using big data technology at work in higher education and how big data technology can promote the work of educators.

Effort Expectancy

Effort expectancy refers to the ease with which users perceive the use of new technologies (Venkatesh et al., 2003). In relation to this research, effort expectancy refers to the fact that educators in higher education find it difficult or easy to use big data technology at work.

Social Influence

Social influence is the degree to which the perceptions of important people around the user will affect their use of a new technology (Venkatesh et al., 2003). For this study, social influence refers to people who are important to educators in higher education, such as colleagues and school leaders, who believe they can use big data technology in their work.

Facilitating Conditions

Facilitating conditions relate to the extent to which users perceive the infrastructure supports the use of new technologies (Venkatesh et al., 2003). For this study, facilitating conditions refer to resources such as technical support, technical tools, and related technical knowledge provided by schools to support educators in using big data technology.

Behavioural Intention

Behavioural intention is the degree to which users are willing to use new technologies (Venkatesh et al., 2003). For this study, behavioural intention is the dependent variable, which refers to the willingness of university educators to use big data technology in their work.

1.8 Summary

In sum, the first chapter provided an introduction and the basic background of the study in relation to big data in education from two perspectives: the global environment and Yunnan Province. This was followed by discussions to provide basic understanding of the problem statement, research objectives, research questions, and hypotheses. Finally, the implications, limitations, and definitions of the key terms related to the study were presented. The following chapter provides a review of the relevant literature in more depth.

REFERENCES

Acevedo, Y. V. N., Marín, C. E. M., Garcia, P. A. G., & Crespo, R. G. (2018, April). A proposal to a decision support system with learning analytics. In *2018 IEEE Global Engineering Education Conference (EDUCON)* (pp. 161-168). IEEE.

Adamopoulos, P. (2013). *What makes a great MOOC? An interdisciplinary analysis of student retention in online courses* [Paper presentation]. Proceedings of the 34th International Conference on Information Systems, ICIS (Vol. 2013), December, Milan, Italy.

Adams, J., Khan, H. T. A., & Raeside, R. (2014). *Research Methods for Business and Social Science Students Second Editiom*. SAGE.

Agaoglu, M. (2016). Predicting instructor performance using data mining techniques in higher education. *IEEE*, *4*, 2379–2387. https://doi.org/10.1109/ACCESS.2016.2568756

Agasisti, T., & Bowers, A. J. (2017). Data analytics and decision making in education: towards the educational data scientist as a key actor in schools and higher education institutions. In *Handbook of Contemporary Education Economics* (pp. 184–210). Edward Elgar Publishing.

Agnihotri, L., & Ott, A. (2014). Building a student at-risk model: An end-to-end perspective from user to data scientist. *Proceedings of the 7th International Conference on Educational Data Mining, EDM*, 209–212.

Aher, S. B., & Lobo, L. M. R. J. (2013). Combination of machine learning algorithms for recommendation of courses in E-Learning System based on historical data. *Knowledge-Based Systems*, *51*, 1–14. https://doi.org/10.1016/j.knosys.2013.04.015

Ahmad, I., Azhar, S., & Lukauskis, P. (2004). Development of a decision support system using data warehousing to assist builders/developers in site selection. *Automation in Construction*, *13*(4), 525–542. https://doi.org/10.1016/j.autcon.2004.03.001

Aiken, L. R. (1994). Some observations and recommendations concerning research methodology in the behavioral sciences. *Educational and Psychological Measurement*, *54*(4), 848–860. https://doi.org/10.1177/00131644940540040

Ajibade, P. (2018). Technology acceptance model limitations and criticisms: Exploring the practical applications and use in technology-related studies, mixed-method, and qualitative researches. *Library Philosophy & Practice*, *1941*. https://digitalcommons.unl.edu/libphilprac/1941

Ajzen, I. (1985). From Intentions to Actions: A Theory of Planned Behavior. In: Kuhl, J., Beckmann, J. (Ed.), *Action Control* (pp. 11-39). Springer. https://doi.org/10.1007/978-3-642-69746-3_2

Akintola, A. R. (2019). *User Adoption of Big Data Analyticsin the Public Sector* [Master's thesis, Linnaeus University]. DiVA. http://urn.kb.se/resolve?urn=urn:nbn:se:lnu:diva-86641%0A

Al-Shawi, A., & Al-Wabil, A. (2013). Internet usage by faculty in Saudi higher education. *International Journal of Computer Science Issues*, *10*(3), 81–87. http://ncys.ksu.edu.sa/sites/ncys.ksu.edu.sa/files/Saudi women 11.pdf

Alazam, A. O., Bakar, A. R., Hamzah, R., & Asmiran, S. (2013). Teachers' ICT skills and ICT integration in the classroom: The case of vocational and technical teachers in Malaysia. *Creative Education*, *3*(8), 70. https://doi.org/10.4236/ce.2012.38B016

Alexander, B. (2008). *Connectivism course draws night, or behold the MOOC*. Infocult: Uncanny Informatics. http://infocult.typepad.com/infocult/2008/07/connectivism-course-draws-night-or-behold-themooc.HTML.

Algarni, A. (2016). Data Mining in Education. *International Journal of Advanced Computer Science and Applications*, *7*(6). https://doi.org/10.14569/ijacsa.2016.070659

Ali Memon, M., Ting, H., Cheah, J.-H., Thurasamy, R., Chuah, F., & Huei Cham, T. (2020). Sample Size for Survey Research: Review and Recommendations. *Journal of Applied Structural Equation Modeling*, *4*(2). https://doi.org/10.47263/JASEM.4(2)01

Ali, W. W., Nor, H. M., Hamzah, A., & Alwi, N. (2009). The conditions and level of ICT integration in Malaysian Smart Schools. *International Journal of Education and Development Using ICT*, *5*(2), 21–31. https://www.proquest.com/scholarly-journals/conditions-level-ict-integration-malaysian-smart/docview/869069991/se-2

Alkhasawneh, S., & Alanazy, S. (2015). Adopt ICT among Academic Staff in Aljouf University: Using UTAUT Model. *Mediterranean Journal of Social Sciences*, *6*(1), 490. https://doi.org/10.5901/mjss.2015.v6n1p490

Allen, C., Smith, M., Rabiee, M., & Dahmm, H. (2021). A review of scientific advancements in datasets derived from big data for monitoring the Sustainable Development Goals. In *Sustainability Science* (Vol. 16, Issue 5). https://doi.org/10.1007/s11625-021-00982-3

Alryalat, M. A., Dwivedi, Y. K., Williams, M. D., & Rana, N. P. (2013). Examining Role of Usefulness, Ease of Use and Social Influence on Jordanian Citizen's Intention to Adopt E-Government. *UK Academy for Information Systems Conference Proceedings 2013*. https://aisel.aisnet.org/ukais2013/4

Alshmrany, S., & Wilkinson, B. (2017). Factors influencing the adoption of ICT by teachers in primary schools in Saudi Arabia. *International Journal of Advanced Computer Science and Applications*, *8*(12), 143–156. https://doi.org/10.14569/IJACSA.2017.081218

Anirban, S. (2014). Big data analytics in the education sector: needs, opportunities and challenges. *International Journal of Research in Computer and Communication Technology*, *3*(11), 1425–1428. https://doi.org/10.2307/j.ctv1gbrzf4.19

Antonenko, P. D., Toy, S., & Niederhauser, D. S. (2012). Using cluster analysis for data mining in educational technology research. *Educational Technology Research and Development*, *60*(3), 383–398. https://doi.org/10.1007/s11423-012-9235-8

Asif, R., Merceron, A., Ali, S. A., & Haider, N. G. (2017). Analyzing undergraduate students' performance using educational data mining. *Computers & Education*, *113*, 177–194. https://doi.org/10.1016/j.compedu.2017.05.007

Aslam, S., & Ashraf, I. (2014). Data mining algorithms and their applications in education data mining. *International Journal*, *2*(7), 50–56.

Attuquayefio, S., & Addo, H. (2014). Review of Studies with UTAUT as Conceptual Framework. *European Scientific Journal*, *10*(8), 249–258. https://doi.org/10.19044/esj.2014.v10n8p%25p

Avella, J. T., Kebritchi, M., Nunn, S. G., & Kanai, T. (2016). Learning Analytics Methods, Benefits, and Challenges in Higher Education: A Systematic Literature Review. *Online Learning*, *20*(2), 13–29.

Awang, Z. (2012). *Research methodology and data analysis second edition.* (2nd ed.). UiTM Press.

Babbie, E. R. (2017). *The basics of social research.* (seventh ed). Cengage learning.

Baker, R. S., Corbett, A. T., & Wagner, A. Z. (2006). Human classification of low-fidelity replays of student actions. *Proceedings of the Educational Data Mining Workshop at the 8th International Conference on Intelligent Tutoring Systems*, 29–36.

Bamiah, S. N., Brohi, S. N., & Rad, B. B. (2018). Big data technology in education: Advantages, implementations, and challenges. *Journal of Engineering Science and Technology*, *13*, 229–241.

Batane, T., & Ngwako, A. (2017). Technology use by pre-service teachers during teaching practice: Are new teachers embracing technology right away in their first teaching experience? *Australasian Journal of Educational Technology*, *33*(1), 48–62. https://doi.org/10.1016/j.semarthrit.2008.03.005

Beheshti, B., & Desmarais, M. (2014). Predictive performance of prevailing approaches to skills assessment techniques: Insights from real vs. synthetic data sets. *Proceedings of the 7th International Conference on Educational Data Mining*, 409–410.

Belli, G. (2009). Nonexperimental quantitative research. In S. D. Lapan & M. T. Quartaroli (Eds.), *Research essentials: An introduction to designs and practices* (pp. 59–77). Thousand Oaks, CA: Jossey-Bass.

Ben-Porath, S., & Ben Shahar, T. H. (2017). Introduction: Big data and education: ethical and moral challenges. *Theory and Research in Education*, *15*(3), 243–248. https://doi.org/10.1177/1477878517737201

Bentler, P. M. (1990). Comparative fit indexes in structural models. *Psychological Bulletin*, *107*(2), 238. https://doi.org/10.1037/0033-2909.107.2.238

Bernacki, M. L., Chavez, M. M., & Uesbeck, P. M. (2020). Predicting achievement and providing support before STEM majors begin to fail. *Computers and Education*, *158*(6). https://doi.org/10.1016/j.compedu.2020.103999

Beyer, M. A., & Laney, D. (2012). *The importance of 'big data': a definition*. Gartner. https://www.gartner.com/doc/2057415

Bienkowski, M., Feng, M., & Means, B. (2012). Enhancing Teaching and Learning through Educational Data Mining and Learning Analytics: An Issue Brief. In *Office of Educational Technology, US Department of Education*. https://tech.ed.gov/ learning-analytics/.

Bier, N., Lip, S., Strader, R., Thille, C., & Zimmaro, D. (2014). An approach to knowledge component/skill modeling in online courses. *Open Learning*, 1–14.

Birch, A., & Irvine, V. (2009). Preservice teachers' acceptance of ICT integration in the classroom: applying the UTAUT model. *Educational Media International*, *46*(4), 295–315. https://doi.org/10.1080/09523980903387506

Blaikie, N. (2007). Approaches to social enquiry: Advancing knowledge (2nd edition). In *Cambridge: Polity Press*.

Bokde, D. K., Girase, S., & Mukhopadhyay, D. (2015). An approach to a university recommendation by multi-criteria collaborative filtering and dimensionality reduction techniques. *2015 IEEE International Symposium on Nanoelectronic and Information Systems*, 231–236. https://doi.org/10.1109/iNIS.2015.36

Bolkan, J. (2013). *Chinese Universities Collaborate to Launch Portal for Blended Learning MOOCs on EdX Platform*. https://campustechnology.com/articles/2013/10/15/chinese-universities-collaborate-to-launch-portal-for-blended-learning-moocs-on-edx-platform.aspx

Bollen, K. A., & Stine, R. (1990). Direct and indirect effects: Classical and bootstrap estimates of variability. *Sociological Methodology*, *20*, 115–140. https://doi.org/10.2307/271084

Briggs, S. (2016). *13 Challenges for Big Data in Education.* TeachThought. https://www.teachthought.com/the-future-of-learning/13-characteristics-data-rich-learning-environment/

Brown, M. (2011). Learning analytics: The coming third wave. *Educause Learning Initiative Brief*, *1*(4), 1–4.

Brown, S. (2010). *Likert scale examples for surveys.* Iowa State University. http://beinspired.no/wp-content/uploads/2019/04/likertscaleexamplesforsurveys.pdf

Brünink, L. A. (2016). *Cross-functional Big Data integration: Applying the UTAUT model* [Master's thesis, University of Twente]. University of Twente Student Thesis. https://essay.utwente.nl/71098/1/Brunink_MA_BMS.pdf

Bu, N. X., Xu, S., Wang, Y, T., Zeng, H. Y., & Wang, J. X. (2018). Research and design of university big data integration and service platform system based on curriculum system. *Electronic Technology & Software Engineering*, *1*, 153–154 [in Chinese].

Buabeng-Andoh, C. (2012). An Exploration of Teachers' Skills, Perceptions and Practices of ICT in Teaching and Learning in the Ghanaian Second-Cycle Schools. *Contemporary Educational Technology*, *3*(1), 36–49. https://doi.org/10.30935/cedtech/6066

Byrne, B. M. (2010). *Structural equation modeling with AMOS: basic concepts, applications, and programming (multivariate applications series)* (2nd ed.). Taylor & Francis Group.

Cabrera-Sánchez, J. P., & Villarejo-Ramos, A. F. (2019). Factors affecting the adoption of big data analytics in companies. *Revista de Administração de Empresas*, *59*(6), 415–429. https://doi.org/10.1590/S0034-759020190607

Cai, M., & Sun, L. (2019). Research on Data Classification and Analysis in Network Education. *Software Guide*, *5*(18), 215–218. https://doi.org/10. 11907/rjdk. 182711 [in Chinese]

Cai, Y. (2018). Interactive teaching of individualization online education via big data. *Journal of Architectural Education in Instit'utions of Higher Learning*, *27*(4), 131–134. https://doi.org/10.11835/j.issn.1005-2909.2018.04.025 [in Chinese]

Cai, Z. W. (2017). A Big Data Platform for Innovation of Teaching Practice in University. *Modern Educational Technology*, *27*(4), 117–123. https://doi.org/10.3969/j.issn.1009-8097.2017.04.018 [in Chinese]

Carlsson, C., Carlsson, J., Hyvonen, K., Puhakainen, J., & Walden, P. (2006, January). Adoption of mobile devices/services-searching for answers with the UTAUT. In *Proceedings of the 39th annual Hawaii international conference on system sciences (HICSS'06)* (Vol. 6, pp. 132a-132a). IEEE. https://doi.org/10.1109/HICSS.2006.38

Cass, T. (1998). A handler for big data. In *Science* (Vol. 282, Issue 5389). https://doi.org/10.1126/science.282.5389.636

Chao, C. M. (2019). Factors determining the behavioral intention to use mobile learning: An application and extension of the UTAUT model. *Frontiers in Psychology*, *10*(JULY), 1–14. https://doi.org/10.3389/fpsyg.2019.01652

Chauhan, S., & Jaiswal, M. (2016). Determinants of acceptance of ERP software training in business schools: Empirical investigation using UTAUT model. *The International Journal of Management Education*, *14*(3), 248–262. https://doi.org/10.1016/j.ijme.2016.05.005

Chen, L., Wang, L., & Zhou, Y. (2022). Research on Data Mining Combination Model Analysis and Performance Prediction Based on Students' Behavior Characteristics. *Mathematical Problems in Engineering*, *2022*. https://doi.org/10.1155/2022/7403037

Chen, R., & Yang, C. (2015). Blended Learning for SPOC. *Distance Education in China*, *5*, 42–47. https://doi.org/10.13541/j.cnki.chinade.2015.05.007 [in Chinese]

Chen, W., & Hirschheim, R. (2004). A paradigmatic and methodological examination of information systems research from 1991 to 2001. *Information Systems Journal*, *14*(3), 197–235. https://doi.org/10.1111/j.1365-2575.2004.00173.x ·

Chen, X. (2021). Optimization of Data Mining and Analysis System for Chinese Language Teaching Based on Convolutional Neural Network. *Computational Intelligence and Neuroscience*, *2021*. https://doi.org/10.1155/2021/1148954

Cheng, G. X. (2017). *Study on the Influence of Big Data on the Education Management of Colleges and Universities in China and the Countermeasures* [Doctoral thesis, Wuhan University]. CNKI. https://cdmd.cnki.com.cn/article/cdmd-10486-1017192249.htm [in Chinese]

China (Kunming) South Asia Social Public Security Technology Exposition. (2018). *China (Yunnan) southeast Asia educational equipment exhibition and educational informatization summit forum*. https://www.163.com/dy/article/DUNV14780518C58M.html

China News Network. (2019). *Mu classroom wisdom teaching makes teaching more efficient*. https://kknews.cc/education/5r39nq8.html

Chinese university Moocs. (2020). *Chinese university Moocs provide free MOOC resources, teaching systems and other services to universities across the country during the epidemic*. https://k.sina.cn/article_5133090466_131f4bea201900mfst.html?from=local

Chung, G. K. W. K. (2014). Toward the relational management of educational measurement data. *Teachers College Record*, *116*(11), 1–16. https://doi.org/10.1177/01614681141160111

Cleveland-Marwick, K. (2015). *Longman dictionary of contemporary English*. Pearson Education Limited. https://www.ldoceonline.com/dictionary/factor

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Lawrence Erlbaum Associates.

Cohen, J. (1992). Statistical power analysis. *Current Directions in Psychological Science*, *1*(3), 98–101. https://doi.org/10.1037/14805-018

Cohen, L., Manion, L., & Morrison, K. (2007). *Research methods in education* (6th ed.). Routledge/Taylor & Francis Group.

Cook, R. D. (1977). Detection of influential observation in linear regression. *Technometrics*, *19*(1), 15–18. https://doi.org/10.1080/00401706.1977.10489493

Cook, R. D., & Weisberg, S. (1982). *Residuals and influence in regression*. Chapman and Hall. https://conservancy.umn.edu/handle/11299/37076

Cormier, D. (2008). *The CCK08 MOOC–Connectivism course, 1/4 way*. Dave's Educational Blog. https://islandscholar.ca/islandora/object/ir:20481

Creswell, J. W. (2012). *Educational Research: Planning, Conducting, and Evaluating Quantitative and Qualitative Research.* (Fourth ed). Pearson. http://lcwu.edu.pk/ocd/cfiles/TESOL/MS-TSL-505/EducationalResearchPlanningConductingandEvaluatingQuantitativeandQualitativeResearch.pdf

Creswell, J. W., & Creswell, J. D. (2017). *Research design: Qualitative, quantitative, and mixed methods approaches*. Sage publications.

Creswell, J. W., & Poth, C. N. (2016). *Qualitative inquiry and research design: Choosing among five approaches*. Sage publications.

Daniel, B. (2014). Big Data and analytics in higher education: Opportunities and challenges. *British Journal of Educational Technology*, *46*(5), 904–920. https://doi.org/10.1111/bjet.12230

Daniel, B. K. (2017). Big Data and data science: A critical review of issues for educational research. *British Journal of Educational Technology*, *50*(1), 101–113. https://doi.org/10.1111/bjet.12595

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, 319–340. https://doi.org/10.2307/249008

Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. (1992). Extrinsic and intrinsic motivation to use computers in the workplace 1. *Journal of Applied Social Psychology*, *22*(14), 1111–1132. https://doi.org/10.1111/j.1559-1816.1992.tb00945.x

De Vaus, D. (2002). *Surveys in Social Research* (5th eds). University College London Press. https://doi.org/10.4324/9780203501054

Decheng, Z., & Jinxin, C. (2018). Curriculum Analysis Based on Chinese University MOOC Platform. *Education Journal*, *7*(3), 68–74. https://doi.org/10.1145/3207677.3277920

Dede, C. J., Ho, A. D., & Mitros, P. (2016). Big data analysis in higher education: Promises and pitfalls. *EDUCAUSE Review.*, *51*(5).

Demoulin, N. T. M., & Coussement, K. (2020). Acceptance of text-mining systems: The signaling role of information quality. *Information and Management*, *57*(1). https://doi.org/10.1016/j.im.2018.10.006

Deng, J., Hu, J. L., Chi, H., & Wu, J. (2010). A study of teaching evaluation in adult higher education based on decision tree. *Proceedings - 2nd International Conference on Information Technology and Computer Science, ITCS 2010*, 381–385. https://doi.org/10.1109/ITCS.2010.99

Desmarais, M. C. (2011, July). Performance comparison of item-to-item skills models with the IRT single latent trait model. *In International Conference on User Modeling, Adaptation, and Personalization* (pp. 75-86). Springer, Berlin, Heidelberg.

Diao, Y. H. (2022). Research on online teaching quality evaluation based on learning analysis. *IOSR Journal of Research & Method in Education (IOSR-JRME)*, *12*(5), 11–21. https://doi.org/10.9790/7388-1205041121

Dishon, G. (2017). New data, old tensions: Big data, personalized learning, and the challenges of progressive education. *Theory and Research in Education*, *15*(3), 272–289. https://doi.org/10.1177/1477878517735233

Drigas, A. S., & Leliopoulos, P. (2012). Factors influencing teachers' adoption and integration of information and communication technology into teaching: A review of the literature. *International Journal of Education & Development Using Information & Communication Technology*, *8*(1), 136–155.

Drigas, A. S., & Leliopoulos, P. (2014). The use of big data in education. *International Journal of Computer Science Issues (IJCSI)*, *11*(5), 58.

Dutta-Bergman, M. J. (2005). Theory and practice in health communication campaigns: A critical interrogation. *Health Communication*, *18*(2), 103–122. https://doi.org/10.1207/s15327027hc1802_1

Ebert, C. (2018). *Big data in education: realities, challenges and opportunities.* Anadea Inc. https://anadea.info/blog/big-data-in-education%0A

Embassy of Switzerland in China. (2014). *Situation Analysis: Massive Open Online Courses (MOOCs) in China.* https://docplayer.net/2414374-Situation-analysis-massive-open-online-courses-moocs-in-china.html

Fan, H., & Cai, D. (2016, August). Social Media in Teaching and Learning--an Example of the Tourism Management Faculty in Haikou. *In 2016 International Conference on Education, E-learning and Management Technology* (pp. 498-507). Atlantis Press.

Fang, Y. Q., & Tian, Q. Y. (2016). Development and design of university education information service platform based on micro-cloud technology. *Journal of Chongqing City Management College*, *16*(1), 84–86 [in Chinese]

Featherman, M. S., & Pavlou, P. A. (2003). Predicting e-services adoption: a perceived risk facets perspective. *International Journal of Human-Computer Studies*, *59*(4), 451–474. https://doi.org/10.1016/S1071-5819(03)00111-3

Feng, L. (2021). Research on Higher Education Evaluation and Decision-Making Based on Data Mining. *Scientific Programming*, *2021*. https://doi.org/10.1155/2021/6195067

Ferguson, R. A. (2012). *The reorder of things: The university and its pedagogies of minority difference*. University of Minnesota Press. https://muse.jhu.edu/book/24877#info_wrap

Field, A. (2013). *Discovering statistics using IBM SPSS statistics.* (4th ed.). sage.

Fishbein, M., & Ajzen, I. (1977). Belief, attitude, intention, and behavior: An introduction to theory and research. *Philosophy and Rhetoric*, *10*(2), 177-I89.

Foon, Y. S., & Fah, B. C. Y. (2011). Internet banking adoption in Kuala Lumpur: an application of UTAUT model. *International Journal of Business and Management*, *6*(4), 161. https://doi.org/10.5539/ijbm.v6n4p161

Fornell, C., & Larcker, D. F. (1981). Structural equation models with unobservable variables and measurement error: Algebra and statistics. *Journal of Marketing Research*, *18*(3), 382–388. https://doi.org/10.1177/002224378101800313

Fraenkel, J. R., Wallen, N. E., & Hyun, H. H. (2016). *How to design and evaluate research in education* (9th ed.). McGraw-Hill Education.

Friis-Healy, E., Nagy, G., & Kollins, S. (2020). Application of Big Data Technology for COVID-19 Prevention and Control in China: Lessons and Recommendations. *Journal of Medical Internet Research*, *22*(10). https://doi.org/10.2196/21980

Gantz, J., & Reinsel, D. (2011). Extracting value from chaos. *IDC Iview*, *1142*(2011), 1–12.

Garone, A., Pynoo, B., Tondeur, J., Cocquyt, C. Vanslambrouck, S. Bruggeman, B., & Struyven, K. (2019). Clustering university teaching staff through UTAUT: Implications for the acceptance of a new learning management system. *British Journal of Educational Technology*, *50*(5), 2466–2483. https://doi.org/10.1111/bjet.12867

Gartner. (2012). *Definition of Big Data*. https://www.gartner.com/en/information-technology/glossary/big-data

Gatewood, R. L., Jr. (2019). *High School Teacher's Acceptance of Technology and Privacy Concerns in the 1:1 Initiative Laptop Program* [Doctoral Dissertation, Mississippi State University]. ProQuest Dissertations & Theses Global. https://www.proquest.com/dissertations-theses/high-school-teacher-s-acceptance-technology/docview/2334771697/se-2

Gay, L. R., Mills, G. E., & Airasian, P. W. (2012). *Educational research: Competencies for analysis and applications* (10th ed.). MA: Pearson.

George, D., & Mallery, P. (2003). *SPSS for Windows step by step: A simple guide andreference* (4th Ed.). Pearson Allyn/Bacon.

Giest, S. (2017). Big data for policymaking: fad or fasttrack? *Policy Sciences*, *50*(3), 367–382. https://doi.org/10.1007/s11077-017-9293-1

Gobert, J. D., Sao Pedro, M., Raziuddin, J., & Baker, R. S. (2013). From log files to assessment metrics: Measuring students' science inquiry skills using educational data mining. *Journal of the Learning Sciences*, *22*(4), 521–563. https://doi.org/10.1080/10508406.2013.837391

Gobert, Janice D., Kim, Y. J., Sao Pedro, M. A., Kennedy, M., & Betts, C. G. (2015). Using educational data mining to assess students' skills at designing and conducting experiments within a complex systems microworld. *Thinking Skills and Creativity*, *18*, 81–90. https://doi.org/10.1016/j.tsc.2015.04.008

Golonka, E. M., Bowles, A. R., Frank, V. M., Richardson, D. L., & Freynik, S. (2014). Technologies for foreign language learning: A review of technology types and their effectiveness. *Computer Assisted Language Learning*, *27*(1), 70–105. https://doi.org/10.1080/09588221.2012.700315

Gorder, L. M. (2008). A study of teacher perceptions of instructional technology integration in the classroom. *Delta Pi Epsilon Journal*, *50*(2), 63–76.

Green, K. C. (2016). *Campus Computing, 2016: The 27th National Survey of Computing and Information Technology in American Higher Education.* The Compus Computing Project. https://static1.squarespace.com/static/5757372f8a65e295305044dc/t/5ba7882df4e1fc683223169a/1537706045853/Campus+Computing+-+2016+Report.pdf

Gu, X. Q., Hu, Y. L., & Cai, H. Y. (2013). Appeal and Response to the Development of MOOCs'Localization in China. *Journal of Distance Education*, *31*(5), 3–11. https://doi.org/10.15881/j.cnki.cn33-1304/g4.2013.05.005 [in Chinese]

Gu, X. Q., Xue, Y. F., & Sun, Y. Y. (2016). Educational Decision-MakingStudies in the Big Data Age: the Power of Data and the Advantages of Stimulation. *Chinese Audio-Visual Education*, *1*, 56–62 [in Chinese]

Guilford, J. P. (1973). *Fundamental statistics in psychology and education*. McGraw-Hill.

Gupta, B., Dasgupta, S., & Gupta, A. (2008). Adoption of ICT in a government organization in a developing country: An empirical study. *Journal of Strategic Information Systems*, *17*(2), 140–154. https://doi.org/10.1016/j.jsis.2007.12.004

Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2010). Structural equations modeling overview. In *Multivariate data analysis* (pp. 541–597). Prentice Hall.

Hair, J. F., Black, W. C., Babin, B. J., Anderson, R. E., & Tatham, R. L. (2006). *Multivariate data analysis 6th Edition.* (6th ed.). Pearson Prentice Hall, Upper Saddle River, NJ. https://tinurll.com/1ko1qi

Hair, J. F., Hult, G. T. M., Ringle, C. M., & Sarstedt, M. (2017). A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM). Thousand Oaks. In *Sage*. Sage.

Hanapiyah, Z. M., Hanafi, W. N. W., & Daud, S. (2018). Issues, challenges and opportunities of big data management in higher education institutions in Malaysia. *Indian Journal of Science and Technology*, *11*(4), 1–6. https://doi.org/10.17485/ijst/2018/v11i4/121088

Hanna, M. (2004). Data Mining in the E-Learning Domain. *Campus-Wide Information Systems*, *21*(1), 29–34. https://doi.org/10.1108/10650740410512301

Harrington, D. (2009). *Confirmatory factor analysis.* Oxford university press.

Hegde, V., & Prageeth, P. P. (2018, January). Higher education student dropout prediction and analysis through educational data mining. In *2018 2nd International Conference on Inventive Systems and Control (ICISC)* (pp. 694-699). IEEE.

Hernández-de-Menéndez, M., Morales-Menendez, R. Escobar, C. A., & Ramírez Mendoza, R. A. (2022). Learning analytics: state of the art. *International Journal on Interactive Design and Manufacturing (IJIDeM) 16, 2022*, 1209–1230. https://doi.org/10.1007/s12008-022-00930-0

Hilliger, I., Aguirre, C., Miranda, C., Celis, S., & Pérez-Sanagustín, M. (2022). Lessons learned from designing a curriculum analytics tool for improving student learning and program quality. *Journal of Computing in Higher Education*, *34*(3), 633–657. https://doi.org/10.1007/s12528-022-09315-4

Hilliger, I., Miranda, C., Celis, S., & Pérez-SanAgustín, M. (2019). Evaluating usage of an analytics tool to support continuous curriculum improvement. *EC-TEL (Practitioner Proceedings), 2437*.

Hinkle, D. E., Wiersma, W., & Jurs, S. G. (1998). Correlation: a measure of relationship. In *Applied statistics for the behavioral sciences* (4th ed, Vol. 4, pp. 105–131). Boston: Houghton Mifflin.

Ho, A. (2017). Advancing educational research and student privacy in the "big data" era. *Workshop on Big Data in Education: Balancing the Benefits of Educational Research and Student Privacy*, 1–18. https://naeducation.org/wp-content/uploads/2017/05/Ho-FINAL.pdf

Ho, C. T. B., Chou, Y. T., & O'Neill, P. (2010). Technology adoption of mobile learning: a study of podcasting. *International Journal of Mobile Communications*, *8*(4), 468–485. https://doi.org/10.1504/IJMC.2010.033837

Ho, R. (2006). *Handbook of univariate and multivariate data analysis and interpretation with SPSS.* CRC press.

Hong, Z., & Li, C. (2018). Research on the Construction of Informatization Teaching Mode in Colleges and Universities under the Background of Big Data. *2018 2nd International Conference on Management, Education and Social Science (ICMESS 2018)*, 285–290. https://doi.org/10.2991/icmess-18.2018.210

Hood-Clark, S. F. (2016). *Influences on the use and behavioral intention to use big data* [Doctoral Dissertation, Capella University]. ProQuest Dissertations & Theses Global. https://www.proquest.com/docview/1846529878?pq-origsite=gscholar&fromopenview=true

Hooper, D., Coughlan, J., & Mullen, M. (2008, September). Evaluating model fit: a synthesis of the structural equation modelling literature. In *7th European Conference on research methodology for business and management studies* (pp. 195-200).

Howell, D. C. (2014). *Fundamental statistics for the behavioral sciences.* (8th ed.). Wadsworth, Cengage Learning.

Hsia, T. C., Shie, A. J., & Chen, L. C. (2008). Course planning of extension education to meet market demand by using data mining techniques - an example of Chinkuo technology university in Taiwan. *Expert Systems with Applications*, *34*(1), 596–602. https://doi.org/10.1016/j.eswa.2006.09.025

Hsu, C. L., & Lin, J. C. C. (2008). Acceptance of blog usage: The roles of technology acceptance, social influence and knowledge sharing motivation. *Information & Management*, *45*(1), 65–74. https://doi.org/10.1016/j.im.2007.11.001

Hu, B. C., & Wang, Z. L. (2015). The role, challenge and educational reform trend of "big data" on education -- a review of the latest research progress of educational reform in the era of big data. *Modern University Education*, *4*, 98–104 [in Chinese]

Hu, D., & Guo, Z. (2017). Exploring deep integration of information technology and China's higher education in the era of big data. *Proceedings - 6th International Conference of Educational Innovation Through Technology, EITT 2017*, 262–267. https://doi.org/10.1109/EITT.2017.71

Huang, A. Y. Q., Lu, O. H. T., Huang, J. C. H., Yin, C. J., & Yang, S. J. H. (2019). Predicting students' academic performance by using educational big data and learning analytics: evaluation of classification methods and learning logs. *Interactive Learning Environments*, *28*(2). https://doi.org/10.1080/10494820.2019.1636086

Huang, J. Q. (2018). Research on the dilemma and countermeasures of ideological and political education in universities in the era of big data. *Journal of Hubei University of Economics*, *15*(12), 109–112. http://www.cnki.com.cn/Article/CJFDTotal-HBRW201812033.htm [in Chinese]

Huang, W., Liu, J., Wang, X., Li, J., Zhang, R., & Liu, Y. (2016). Application of mobile learning and big data on improving flipped classroom and MOOCs. *Transactions on Computer Science and Engineering*, *3*, 1–7. https://doi.org/10.12783/dtcse/icte2016/4765

Hubei Provincial Department of Education. (2020). *Notice of the Hubei Provincial Department of Education on Doing a Good Job in College Teaching during the Period of Epidemic Prevention and Control*. http://jyt.hubei.gov.cn/zfxxgk/zc_GK2020/qtzdgkwj_GK2020/202010/t20201026_2976793.shtml

Hussain, M., Al-Mourad, M. B., & Mathew, S. S. (2016, March). Collect, Scope, and Verify Big Data--A Framework for Institution Accreditation. In *2016 30th International Conference on Advanced Information Networking and Applications Workshops (WAINA)* (pp. 187-192). IEEE.

Hutchinson, T., Waters, A., & Swan, M. (1987). *English for specific purposes*. Cambridge university press.

Im, K. S., & Grover, V. (2004). The use of structural equation modeling in IS research: review and recommendations. In *The handbook of information systems research* (pp. 44–65). Idea Group Inc. https://doi.org/10.4018/978-1-59140-144-5.ch004

Informatica. (2012). *Informatica 9.5 Maximizes Return on Big Data*. https://www.bobsguide.com/2012/05/16/informatica-9-5-maximizes-return-on-big-data/

Jain, P., Gyanchandani, M., & Khare, N. (2016). Big data privacy: a technological perspective and review. *Journal of Big Data*, *3*(25), 2–25. https://doi.org/10.1186/s40537-016-0059-y

Jeong, H., & Biswas, G. (2008). Mining Student Behavior Models in Learning-by-Teaching Environments. *Educational Data Mining 2008*, 127–136.

Jiang, C., Wang, Q., Qing, W., Zhu, L., Cheng, S., & Wang, H. (2019). The Present of Education Big Data Research in China: Base on the Bibliometric Analysis and Knowledge Mapping. *Journal of Physics: Conference Series*, *1187*(5). https://doi.org/10.1088/1742-6596/1187/5/052039

Jiao, L. P. (2019). An Analysis of Comprehensive Quality Evaluation Model of College Students Based on Background of Education in Era of Big Data—Taking Fujian Forestry Vocational and Technical College as an Example. *Teaching of Forestry Region*, *11*, 58–61. https://doi.org/10.3969/j.issn1008-6714.2019.11.018 [in Chinese]

Jiao, W. H., & Feng, X. J. (2018). Research and analysis of hybrid teaching model based on big data. *The Chinese Journal of ICT in Education*, *21*, 38–41. http://www.cqvip.com/qk/98487c/201821/676711609.html [in Chinese]

Johnson, B. (2001). Toward a new classification of nonexperimental quantitative research. *Educational Researcher*, *30*(2), 3–13. https://doi.org/10.3102/0013189X030002

Johnson, L., Adams, S., Cummins, M., Estrada, V., Freeman, A., & Hall, C. (2012). *The NMC Horizon Report 2012 Higher Education Edition*. The New Media Consortium. Austin, Texas.

Johnson, L., Smith, R., Willis, H., Levine, A., & Haywood, K. (2011). *The 2011 Horizon Report*. The New Media Consortium, Austin, Texas.

Jones, K. M., & Salo, D. (2017). Learning analytics and the academic library: Professional ethics commitments at a crossroads. In *College & Research Libraries, Forthcoming*.

Jones, S. J. (2012). Technology review: the possibilities of learning analytics to improve learner-centered decision-making. *The Community College Enterprise*, *18*(1), 89–92.

Kaplan, A. M., & Haenlein, M. (2016). Higher education and the digital revolution: About MOOCs, SPOCs, social media, and the Cookie Monster. *Business Horizons*, *59*(4), 441–450. https://doi.org/10.1016/j.bushor.2016.03.008

Karmakar, S., Laguë, C., Agnew, J., & Landry, H. (2007). Integrated decision support system (DSS) for manure management: A review and perspective. *Computers and Electronics in Agriculture*, *57*(2), 190–201. https://doi.org/10.1016/j.compag.2007.03.006

Kay, R. (2006). Addressing gender differences in computer ability, attitudes and use: The laptop effect. *Journal of Educational Computing Research*, *34*(2), 187–211. https://doi.org/10.2190/9BLQ-883Y-XQMA-FCAH

Keith, T. Z. (2019). *Multiple regression and beyond: An introduction to multiple regression and structural equation modeling*. (3rd Editio). Routledge. https://doi.org/https://doi.org/10.4324/9781315162348

Keshtkar, F., Burkett, C., Li, H., & Graesser, A. C. (2014). Using data mining techniques to detect the personality of players in an educational game. In *Educational data mining* (pp. 125–150). Springer, Cham.

Kim, H., Ku, B., Kim, J. Y., Park, Y.-J., & Park, Y.-B. (2016). Confirmatory and Exploratory Factor Analysis for Validating the Phlegm Pattern Questionnaire for Healthy Subjects. *Evidence-Based Complementary and Alternative Medicine*, *2016*, 1–8. https://doi.org/10.1155/2016/2696019

Kinnebrew, J. S., & Biswas, G. (2012). Identifying Learning Behaviors by Contextualizing Differential Sequence Mining with Action Features and Performance Evolution. *The International Conference on Educational Data Mining (EDM)*.

Klašnja-Milićević, A., Ivanović, M., & Stantić, B. (2020). Designing Personalized Learning Environments—The Role of Learning Analytics. *Vietnam Journal of Computer Science*, *7*(03), 231–250. https://doi.org/10.1142/S219688882050013X

Kline, R. B. (2015). *Principles and practice of structural equation modeling.* (F. Ed. (ed.)). Guilford publications.

Krysik, J., & Finn, J. (2013). *Research for effective social work practice*. Routledge. https://doi.org/org/10.4324/9780203077894

Kularbphettong, K. (2017, September). Analysis of students' behavior based on educational data mining. In *Proceedings of the Computational Methods in Systems and Software* (pp. 167-172). Springer, Cham.

Kwon, D., Kim, H., Kim, J., Suh, S. C., Kim, I., Kuinam, ·, Kim, J., & Kuinam, B. (2019). A survey of deep learning-based network anomaly detection. *Cluster Computing*, *22*(1), 949–961. https://doi.org/10.1007/s10586-017-1117-8

Lau, B. T., & Sim, C. H. (2008). Exploring the extent of ICT adoption among Secondary school teachers In Malaysia. *International Journal of Computing and ICT Research*, *2*(2), 19–36. http://www.ijcir.org/volume2-number2/article3.pdf.

Lee, J. H., & Song, C. H. (2013). Effects of trust and perceived risk on user acceptance of a new technology service. *Social Behavior and Personality: An International Journal*, *41*(4), 587–597. https://doi.org/10.2224/sbp.2013.41.4.587

Lee, J. I., & Brunskill, E. (2012). The Impact on Individualizing Student Models on Necessary Practice Opportunities. *International Educational Data Mining Society*.

Legris, P., Ingham, J., & Collerette, P. (2003). Why do people use information technology? A critical review of the technology acceptance model. *Information & Management*, *40*(3), 191–204. https://doi.org/10.1016/S0378-7206(01)00143-4

Lei, P. W., & Wu, Q. (2007). Introduction to structural equation modeling: Issues and practical considerations. *Educational Measurement: Issues and Practice*, *26*(3), 33–43. https://doi.org/10.1111/j.1745-3992.2007.00099.x

Lemay, D. J., Baek, C., & Doleck, T. (2021). Comparison of learning analytics and educational data mining: A topic modeling approach. *Computers and Education: Artificial Intelligence*, *2*. https://doi.org/10.1016/j.caeai.2021.100016

Li, H., & Sun, H. (2020). Research on Online Education Based on Big Data. *Journal of Physics: Conference Series*, *1624*. https://doi.org/10.1088/1742-6596/1624/3/032043

Li, M., & Chen, X. L. (2018). Self-adaptation in big data environment Online learning platform learning analysis model design. *Science & Technology Information*, *2*, 169–172. http://www.cnki.com.cn/Article/CJFDTotal-ZXLJ201806100.htm [in Chinese]

Li, S. Q. (2019). Educational management and decision optimization from the perspective of big data. *Think Tank Era*, *20*, 168–173. http://www.kgtsg.com/qikan/7c8e713c44ac4954064033a24a45fae6.html

Li, Y. (2019). MOOCs in Higher Education: Opportunities and Challenges. *2019 5th International Conference on Humanities and Social Science Research (ICHSSR 2019)*, 48–55. https://doi.org/10.2991/ichssr-19.2019.10

Li, Y. F., Zhang, H. F., Liu, S. L., & Tan, B. (2019). Advances in research on educational data mining. *Computer Engineering and Applications*, *55*(14), 15–23. http://www.cqvip.com/qk/91690x/201914/7002406533.html [in Chinese]

Li, Y., & Zhai, X. (2018). Review and prospect of modern education using big data. *Procedia Computer Science*, *129*, 341–347. https://doi.org/10.1016/j.procs.2018.03.085

Liao, P., & Xie, Q. H. (2019). Study on the Precision Guidance Model of Employment and Entrepreneurship of Poor Students in Higher Vocational Education under the Big Data Environment. *2019 5th International Conference on Education, Management and Information Technology*, 296–299. https://doi.org/10.25236/icemit.2019.047

Lin, C. F., Yeh, Y. C., Hung, Y. H., & Chang, R. I. (2013). Data mining for providing a personalized learning path in creativity: An application of decision trees. *Computers and Education*, *68*, 199–210. https://doi.org/10.1016/j.compedu.2013.05.009

Liñán, L. C., & Pérez, Á. A. J. (2015). Educational Data Mining and Learning Analytics: differences, similarities, and time evolution. *International Journal of Educational Technology in Higher Education*, *12*(3), 98–112. https://doi.org/10.7238/rusc.v12i3.2515

Lind, D. A., Marchal, W. G., & Wathen, S. A. (2013). *Basic Statistics for Business and Economic* (9th ed.). McGraw-Hill Education (Asia).

Liu, H., & Xia, Y. (2011). Notice of Retraction: Teaching evaluation system based on Association Rule Mining. In *Proceedings - PACCS 2011: 2011 3rd Pacific-Asia Conference on Circuits, Communications and System* (pp. 1–3). https://doi.org/10.1109/PACCS.2011.5990335

Liu, Q., & Peng, Y. (2013). A Method of Unstructured Information Process in Computer Teaching Evaluation System Based on Data Mining Technology. *2013 International Conference on Communication Systems and Network Technologies*, 688–692. https://doi.org/10.1109/CSNT.2013.147

Liu, X. (2022). The Study on National Security in Big Data Era. *Frontiers in Business, Economics and Management*, *5*(3), 191–200. https://doi.org/org/10.54097/fbem.v5i3.2006

Liu, Y. Q., & Yang, X. M. (2014). New ideas for the balanced development of regional education in the era of big data. *Educational Technology Research*, *35*(05), 11–14. https://doi.org/10.13811/j.cnki.eer.2014.05.002 [in Chinese]

Lomax, R. G., & Schumacker, R. E. (2012). *A beginner's guide to structural equation modeling* (3rd ed.). Routledge Academic New York.

Long, H., & Huo, N. (2019). Establishment and practice of teaching evaluation system based on big data analysis. *Computer Knowledge and Technology*, *15*(15), 19–20. https://doi.org/10.14004/j.cnki.ckt.2019.1571 [in Chinese]

Lu, J., Wu, D., Mao, M., Wang, W., & Zhang, G. (2015). Recommender system application developments: a survey. *Decision Support Systems*, *74*, 12–32. https://doi.org/10.1016/j.dss.2015.03.008

Lu, L. Q., S, Q., Li, J., Q, H. O., & P, Y. E. (2020). Online Teaching Practice of Analytical Chemistry Based on the Combination of China University MOOC, MOOC Classroom and QQ Group. *University Chemistry*, *35*(5), 15–18. https://doi.org/10.3866/PKU.DXHX202002042

Lu, Y., & Cao, K. (2019). Spatial analysis of big data industrial agglomeration and development in China. *Sustainability*, *11*(6), 1783. https://doi.org/10.3390/su11061783

Lucko, G., & Rojas, E. M. (2010). Research validation: Challenges and opportunities in the construction domain. *Journal of Construction Engineering and Management*, *136*(1), 127–135. https://doi.org/10.1061/(ASCE)CO.1943-7862.0000025

Luo, Y., Zhou, G., & Li, J. (2018, October). Comparing the Chinese University MOOC Platform to the Three Major MOOC Players. In *Proceedings of the 2nd International Conference on Computer Science and Application Engineering* (pp. 1-5). https://doi.org/10.1145/3207677.3277920

Lutfiani, N., & Meria, L. (2022). Utilization of Big Data in Educational Technology Research. *International Transactions on Education Technology (ITEE)*, *1*(1), 73–83.

Ma, J. . (2020). Research on the Application of Data Mining Technology in Educational Management System. *Journal of Education and Practice*, *11*(8), 108–112. https://doi.org/10.7176/jep/11-8-14

Ma, R. (2019). *The Emergence of China's Nationally-Recognized MOOCs*. https://www.classcentral.com/report/china-national-moocs/

Madamshetty, L., & Naidu, K. S. B. (2019). *Integrating big data in higher education: Perspectives and challenges.* EE Publishers.

Manyika, J., Chui, M., Brown, B., Bughin, J., & Dobbs, R. (2011). *Big data: The next frontier for innovation, competition, and productivity*. McKinsey Global Institute.

Markauskaite, L. (2006). Gender issues in preservice teachers' training: ICT literacy and online learning. *Australasian Journal of Educational Technology*, *22*(1). https://doi.org/10.14742/ajet.1304

Márquez-Vera, C., Cano, A., Romero, C., Noaman, A. Y. M., Mousa Fardoun, H., & Ventura, S. (2016). Early dropout prediction using data mining: A case study with high school students. *Expert Systems*, *33*(1), 107–124. https://doi.org/10.1111/exsy.12135

Marsh, H. W., Hau, K. T., & Grayson, D. (2005). Goodness of fit in structural equation models. In *Contemporary psychometrics* (pp. 275–340). Lawrence Erlbaum Associates. https://books.google.com.my/books?hl=en&lr=lang_en&id=ZoR5AgAAQBAJ&oi=fnd&pg=PP1&dq=Contemporary+psychometrics+2005&ots=URFqwfHmIo&sig=ihs06Mj2ztRWWnmGXuK1nqLu4-8&redir_esc=y#v=onepage&q=Contemporary psychometrics 2005&f=false

Maseleno, A., Sabani, N., Huda, M., Ahmad, R., Jasmi, K. A., & Basiron, B. (2018). Demystifying learning analytics in personalised learnin. *International Journal of Engineering and Technology(UAE)*, *7*(3), 1124–1129. https://doi.org/10.14419/ijet.v7i3.9789

Mayer-Schönberger, V., & Cukier, K. (2013). *Big data: A revolution that will transform how we live, work, and think*. Houghton Mifflin Harcourt.

Means, B., & Anderson, K. (2013). *Expanding Evidence Approaches for Learning in a Digital World*. https://files.eric.ed.gov/fulltext/ED566873.pdf

Meng, L. L., Gu, X. Q., & Li, Z. (2014). Comparative study of learning analysis. *Open Education Research*, *20*(4), 66–75.

Meng, Z. Y., Lu, X., & Hu, F. G. (2017). Theoretical Path and Application Thinking on the Realistic Way of Big Data -- Driven Education: A Review of the First Chinese Education Big Data Development Forum. *Journal of Distance Education*, *35*(2), 9–18. https://doi.org/10.15881/j.cnki.cn33-1304/g4.2017.02.002 [in Chinese]

Menon, A., Gaglani, S., Haynes, M. R., & Tackett, S. (2017). Using "big data" to guide implementation of a web and mobile adaptive learning platform for medical students. *Medical Teacher*, *39*(9), 975–980. https://doi.org/10.1080/0142159X.2017.1324949

Meyers, L. S., Gamst, G., & Guarino, A. J. (2016). *Applied multivariate research: Design and interpretation.* Sage publications.

Ministry of Education of the People's Republic of China. (2020). *Number of Higher Education Institutions.* http://m.moe.gov.cn/s78/A03/moe_560/jytjsj_2019/gd/202006/t20200611_464854.html

Ministry of Education of the People's Republic of China. (2019). *China's education modernization 2035*. https://internationaleducation.gov.au/international-network/china/PolicyUpdates-China/Pages/China's-education-modernisation-plan-towards-2035-.aspx

Ministry of Education of the People's Republic of China. (2020a). *Central China normal university has made scientific and accurate efforts to prevent and control the epidemic disease in an all-round way*. http://www.moe.gov.cn/jyb_xwfb/s6192/s133/s201/202003/t20200305_427855.html

Ministry of Education of the People's Republic of China. (2020b). *Guiding Opinions of the Office of the Leading Group for Responding to the Novel Coronavirus Infection Pneumonia Epidemic of the Ministry of Education on Doing a Good Job in the Organization and Management of Online Teaching in Regular Colleges and Univers.* http://www.moe.gov.cn/srcsite/A08/s7056/202002/t20200205_418138.html

Ministry of Industry and Information Technology of the People's Republic of China. (2017). *China: MIIT releases 2016–2020 Big Data plan*. https://www.dataguidance.com/news/china-miit-releases-2016–2020-big-data-plan

Moore, G. C., & Benbasat, I. (1991). Development of an instrument to measure the perceptions of adopting an information technology innovation. *Information Systems Research, 2*(3), 192–222. https://doi.org/10.1287/isre.2.3.192

Mou, K., & Xu, B. (2022). Research on Teaching Quality Evaluation System Based on Data Mining. *2022 IEEE 10th Joint International Information Technology and Artificial Intelligence Conference (ITAIC)*, 2643–2647. https://doi.org/10.1109/ITAIC54216.2022.9836678.

Mtebe, J., & Raisamo, R. (2014). Investigating students' behavioural intention to adopt and use mobile learning in higher education in East Africa. *International Journal of Education and Development Using ICT, 10*(3). https://www.learntechlib.org/p/148476/.

Mulaik, S. A., James, L. R., Van Alstine, J., Bennett, N., Lind, S., & Stilwell, C. D. (1989). Evaluation of goodness-of-fit indices for structural equation models. *Psychological Bulletin, 105*(3), 430. https://doi.org/10.1037/0033-2909.105.3.430

Murphy, M., Redding, S., & Twyman, J. (2016). *Handbook on personalized learning for states, districts, and schools*. IAP.

Naing, L., Winn, T., & Rusli, B. N. (2006). Practical issues in calculating the sample size for prevalence studies. *Archives of Orofacial Sciences, 1*, 9–14.

Nanjing University of Aeronautics and Astronautics, N. U. of A. and A. (2020). *Notice on using iCourse (Chinese University MOOC) platform to carry out online teaching*. https://aao.nuaa.edu.cn/2020/0214/c8230a193598/page.htm

Natek, S., & Zwilling, M. (2014). Student data mining solution–knowledge management system related to higher education institutions. *Expert Systems with Applications*, *41*(14), 6400–6407. https://doi.org/10.1016/j.eswa.2014.04.024

Nawrot, I., & Doucet, A. (2014, April). Building engagement for MOOC students: introducing support for time management on online learning platforms. In *Proceedings of the 23rd International Conference on world wide web* (pp. 1077-1082). https://doi.org/10.1145/2567948.2580054

Nesterko, S. O. Dotsenko, S., Han, Q., Seaton, D., Reich, J., Chuang, I., & Ho, A. D. (2013). Evaluating the geographic data in MOOCs. *In Neural Information Processing Systems*.

Ngai, E. W., Poon, J. K. L., & Chan, Y. H. (2007). Empirical examination of the adoption of WebCT using TAM. *Computers & Education*, *48*(2), 250–267. https://doi.org/10.1016/j.compedu.2004.11.007

Norusis, M. J. (1992). *SPSS for Windows: Advanced statistics release 5.* Incorporated., SPSS.

Nunnaly, J. C. (1978). *Psychometric theory. New theory.* (2nd ed.). McGraw-Hill.

Okubo, F., Yamashita, T., Shimada, A., & Ogata, H. (2017, March). A neural network approach for students' performance prediction. In *Proceedings of the seventh international learning analytics & knowledge conference* (pp. 598-599). https://doi.org/10.1145/3027385.3029479

Olaya, D., Vásquez, J., Maldonado, S., Miranda, J., & Verbeke, W. (2020). Uplift Modeling for preventing student dropout in higher education. *Decision Support Systems*, *134*. https://doi.org/10.1016/j.dss.2020.113320

Olmos, M. M., & Corrin, L. (2012). Learning analytics: a case study of the process of design of visualizations. *Journal of Asynchronous Learning Networks*, *16*(3), 39–49. https://doi.org/10.24059/olj.v16i3.273

OLPAK, Y. Z., & YAĞCI, M. (2022). Using Big Data in Education: Curriculum Review with Educational Data Mining. *Journal of Teacher Education and Lifelong Learning*, *4*(2), 181–195. https://doi.org/10.51535/tell.1192930

olusola Olayiwola, I., & Alimi, K. M. (2015). Preparedness of colleges of education in Southwestern Nigeria for the Adoption of Blended Learning. *Journal of Education and Learning*, *9*(1), 25–34. https://doi.org/10.11591/edulearn.v9i1.1279

Onwuagboke, B. B. C., & Singh, T. K. R. (2016). Faculty attitude and use of ICT in instructional delivery in tertiary institutions in a developing nation. *International Journal of Research Studies in Educational Technology*, *5*(1), 77–88. https://doi.org/10.5861/ijrset.2016.1428

Orcher, L. T. (2016). *Conducting research: Social and behavioral science methods*. Routledge.

Osakwe, J., Iyawa, G., Ujakpa, M. M., Amunkete, K., & Obande, B. O. (2020). Barriers to the Implementation of Big Data Technology in Education: An Empirical Study. *2020 IST-Africa Conference, IST-Africa 2020*, 1–9.

Oye, N. D., A.Iahad, N., & Ab. Rahim, N. Z. (2012). A comparative study of acceptance and use of ICT among university academic staff of ADSU and LASU: Nigeria. *Journal of Science and Technology*, *1*(2), 103–115.

Oye, N., Iahad, N. A., & Ab Rabin, Z. (2011). A Model of ICT Acceptance and Use for Teachers in Higher Education Institutions. *International Journal of Computer Science & Communication Networks*, *1*(1), 22–40. http://eprints.utm.my/id/eprint/37830/3/ijcscn2011010105.pdf

Palazuelos, C., García-Saiz, D., & Zorrilla, M. (2013, September). Social network analysis and data mining: An application to the e-learning context. In *International Conference on Computational Collective Intelligence* (pp. 651-660). Springer, Berlin, Heidelberg.

Pallant, J. (2010). *SPSS Survival Manual: A step by step guide to data analysis using SPSS* (4th ed.). McGraw Hill.

Papamitsiou, Z., & Economides, A. A. (2014). Learning analytics and educational data mining in practice: A systemic literature review of empirical evidence. *Educational Technology and Society*, *17*(4), 49–64. https://www.proquest.com/docview/1660157007

Pappano, L. (2012). The Year of the MOOC. *The New York Times*, *2*(12), 2012.

Parson, G. K. (2021). *Factors Affecting Information Technology Professionals' Decisions to Adopt Big Data Analytics Among Small- and Medium-Sized Enterprises: A Quantitative Study* [Doctoral Dissertation, Capella University]. ProQuest Dissertations & Theses Global. https://www.proquest.com/docview/2502873330?pq-origsite=gscholar&fromopenview=true

Passow, H. J. (2012). Which ABET competencies do engineering graduates find most important in their work? *Journal of Engineering Education*, *101*(1), 95–118. https://doi.org/10.1002/j.2168-9830.2012.tb00043.x

Paver, J., Walker, D. A., & Hung, W. C. (2014). Factors that predict the integration of technology for instruction by community college adjunct faculty. *Community College Journal of Research and Practice*, *38*(1), 68–85. https://doi.org/10.1080/10668926.2013.799449

People's Government of Yunnan Province. (2021). *The Fourteenth Five-Year Plan for the National Economic and Social Development of Yunnan Province and the Outline of the 2035 Long-Term Goals*. http://www.yn.gov.cn/zwgk/zcwj/zxwj/202102/t20210209_217052.html

Pham, T., Dang, L., & Le, T. (2020). Factors affecting teachers' behavioral intention of using information technology in lecturing-economic universities. *Management Science Letters*, *10*(11), 2665–2672. https://doi.org/10.5267/j.msl.2020.3.026

Picciano, A. G. (2012). The evolution of big data and learning analytics in American higher education. *Journal of Asynchronous Learning Networks*, *16*(3), 9–20. https://doi.org/10.24059/olj.v16i3.267

Pouyanfar, S., Yang, Y., Chen, S. C., Shyu, M. L., & Iyengar, S. S. (2018). Multimedia big data analytics: A survey. *ACM Computing Surveys (CSUR)*, *51*(1), 1–34. https://doi.org/10.1145/3150226

PRC Ministry of Industry and Information Technology. (2022). *"14th Five-Year" Plan for the Development of the Big Data Industry*. https://cset.georgetown.edu/publication/14th-five-year-plan-for-the-development-of-the-big-data-industry/

Prinsloo, P., Archer, E., Barnes, G., Chetty, Y., & Van Zyl, D. (2015). Big(ger) data as better data in open distance learning. *The International Review of Research in Open and Distributed Learning*, *16*(1), 284–306. https://doi.org/10.19173/irrodl.v16i1.1948

Provost, F., & Fawcett, T. (2013). *Data Science for Business. What You Need to Know About Data Mining and Data-Analytic Thinking* (pp. 47–58). California: O' Reilly.

Pynoo, B., Devolder, P., Tondeur, J., Van Braak, J., Duyck, W., & Duyck, P. (2011). Predicting secondary school teachers' acceptance and use of a digital learning environment: A cross-sectional study. *Computers in Human Behavior*, *568–575*(1), 568–575. https://doi.org/10.1016/j.chb.2010.10.005

Queiroga, E. M., Lopes, J. L., Kappel, K., Aguiar, M., Araújo, R. M., Munoz, R., Villarroel, R., & Cechinel, C. (2020). A learning analytics approach to identify students at risk of dropout: A case study with a technical distance education course. *Applied Sciences (Switzerland)*, *10*(11). https://doi.org/10.3390/app10113998

Queiroz, M. M., & Pereira, S. C. F. (2019). Intention to adopt big data in supply chain management: A Brazilian perspective. *RAE Revista de Administracao de Empresas*, *59*(6). https://doi.org/10.1590/S0034-759020190605

Radovan, M., & Kristl, N. (2017). Acceptance of Technology and Its Impact on Teachers' Activities in Virtual Classroom: Integrating UTAUT and CoI into a Combined Model. *Turkish Online Journal of Educational Technology-TOJET*, *16*(3), 11–22. https://files.eric.ed.gov/fulltext/EJ1152624.pdf

Raghavendra, R., Ranganathan, P., Talwar, V., Wang, Z., & Zhu, X. (2008, March). No" power" struggles: coordinated multi-level power management for the data center. In *Proceedings of the 13th international conference on Architectural support for programming languages and operating systems* (pp. 48-59).

Ray, S., & Saeed, M. (2018). Applications of educational data mining and learning analytics tools in handling big data in higher education. In *Applications of Big Data Analytics: Trends, Issues, and Challenges* (pp. 135–160). Springer, Cham. https://doi.org/10.1007/978-3-319-76472-6_7

Rencher, A. C., & Christensen, W. F. (2012). *Methods of Multivariate Analysis* (3rd Editio). John Wiley & Sons.

Romero, C., & Ventura, S. (2010). Educational data mining: a review of the state of the art. *IEEE Transactions on Systems, Man, and Cybernetics, Part C (Applications and Reviews)*, *40*(6), 601–618. https://doi.org/10.1109/TSMCC.2010.2053532

Romero, C., & Ventura, S. (2013). Data mining in education. *Wiley Interdisciplinary Reviews: Data Mining and Knowledge Discovery*, *3*(1), 12–27.

Romero, Cristobal, & Ventura, S. (2020). Educational data mining and learning analytics: An updated survey. *Wiley Interdisciplinary Reviews: Data Mining and Knowledge Discovery*, *10*(3). https://doi.org/10.1002/widm.1355

Ru, M. (2022). Research on the New Model of Data-Driven Teaching Decision-Making for University Minority Language Majors. *Frontiers in Psychology*, *13*. https://doi.org/10.3389/fpsyg.2022.901256

Ruipérez-Valiente, J. A., Muñoz-Merino, P. J., & Delgado Kloos, C. (2017). Detecting and clustering students by their gamification behavior with badges: A case study in engineering education. *International Journal of Engineering Education*, *33*(2), 816–830. http://hdl.handle.net/20.500.12761/519

Ruiz-Palmero, J., Colomo-Magaña, E., Ríos-Ariza, J. M., & Gómez-García, M. (2020). Big data in education: Perception of training advisors on its use in the educational system. *Social Sciences*, *9*(4), 53. https://doi.org/10.3390/socsci9040053

Russom, P. (2011). Big data analytics. *TDWI Best Practices Report*, *19*(4), 1–34. https://vivomente.com/wp-content/uploads/2016/04/big-data-analytics-white-paper.pdf

Saade, R., Nebebe, F., & Tan, W. (2007). Viability of the" technology acceptance model" in multimedia learning environments: a comparative study. *Interdisciplinary Journal of E-Learning and Learning Objects*, *3*(1), 175–184. https://doi.org/10.28945/392

Sahid, N. Z., Sani, M. K. J. A., Noordin, S. A., Zaini, M. K., & Baba, J. (2021). Determinants factors of intention to adopt big data analytics in malaysian public agencies. *Journal of Industrial Engineering and Management*, *14*(2). https://doi.org/10.3926/jiem.3334

Schneider, D. K. (2009). Methodology tutorial-descriptive statistics and scales. *Research Methodology Tutorials*. https://doi.org/https://edutechwiki.unige.ch/en/Methodology_tutorial_-_descriptive_statistics_and_scales

Scott, R. H., & Fisher, D. L. (2004). Development, validation and application of a Malay translation of an elementary version of the Questionnaire on Teacher Interaction. *Research in Science Education*, *34*(2), 173–194. https://doi.org/10.1023/B:RISE.0000033759.09807.50

Segars, A. H., & Grover, V. (1993). Re-examining perceived ease of use and usefulness: A confirmatory factor analysis. *MIS Quarterly*, *17*(4), 517–525. https://doi.org/10.2307/249590

Sek, Y. W., Lau, S. H., Teoh, K. K., Law, C. Y., & Parumo, S. B. (2010). Prediction of user acceptance and adoption of smart phone for learning with technology acceptance model. *Journal of Applied Sciences (Faisalabad)*, *10*(20), 2395–2402. https://doi.org/10.3923/jas.2010.2395.2402

Serben, D. F. (2014). *The examination of factors influencing social media usage by African American small business owners using the UTAUT model* [Doctoral Dissertation, Capella University]. ProQuest Dissertations & Theses Global. https://www.proquest.com/docview/1529461309?pq-origsite=gscholar&fromopenview=true

Seyal, A. H., Rahman, M. N. A., & Rahim, M. M. (2002). Determinants of academic use of the Internet: a structural equation model. *Behaviour & Information Technology*, *21*(1), 71–86. https://doi.org/10.1080/01449290210123354

Shen, G. Q. (2019). Application research of big data analysis in college wisdom education. *Modern Electronics Technique*, *4*(42), 97–100. https://doi.org/10.16652/j.issn.1004- 373x.2019.04.023 [in Chinese]

Shi, J., & Wu, Y. (2022). Research on Organization Design of College Chinese Teaching under Big Data Environment. *Journal of Environmental and Public Health*, *2022*. https://doi.org/10.1155/2022/2774072

Shi, Q. P., & Yu, N. G. (2015). Research on the influence of big data technology on physical education in primary and secondary schools. *Contemporary Sports Technology*, *5*(26), 245–248. https://doi.org/10.16655/j.cnki.2095-2813.2015.26.245 [in Chinese]

Siemens, G. (2010). *What are learning analytics*. ELEARNSPACE: Learning, Networks, Knowledge, Technology, Community. http://www.elearnspace.org/blog/2010/08/25/whatare-learning-analytics/

Siemens, G., & Baker, R. S. D. (2012). Learning analytics and educational data mining: towards communication and collaboration. *Proceedings of the 2nd International Conference on Learning Analytics and Knowledge*, 252–254.

Siemens, G., & Long, P. (2011). Penetrating the Fog: Analytics in Learning and Education. *EDUCAUSE Review*, *46*(5), 30–40.

Sin, K., & Muthu, L. (2015). APPLICATION OF BIG DATA IN EDUCATION DATA MINING AND LEARNING ANALYTICS--A LITERATURE REVIEW. *ICTACT Journal on Soft Computing*, *5*(4), 1035–1049. https://doi.org/10.21917/ijsc.2015.0145

Singleton, A., & Straits, C. (2004). *Approaches to social research* (4th ed.). Oxford University Press.

SOMAmetrics. (2018). *The top six big data challenges in education*. SOMAmetrics. https://www.somametrics.com/top-six-big-data-challenges-education/

Song, I.-Y., & Zhu, Y. (2017). Big Data and Data Science: Opportunities and Challenges of iSchools. *Journal of Data and Information Science*, *2*(3), 1–18. https://doi.org/10.1515/jdis-2017-0011

Ssekibaamu, J. B. (2015). *Technology and education: A quantitative study of the acceptance of gaming as a teaching tool using the Unified Theory of Acceptance and Use of Technology (UTAUT)* [Doctoral Dissertation, Capella University]. ProQuest Dissertations & Theses Global. https://www.proquest.com/docview/1712386935?pq-origsite=gscholar&fromopenview=true

State Council of China. (2015). *The State Council on the issuance of the action plan to promote the development of big data*. http://www.gov.cn/zhengce/content/2015-09/05/content_10137.htm

Stein, L. A. (2012). Casting a Wider Net. *Science*, *338*(6113), 1422–1423. https://doi.org/10.1126/science.1230710

Sun, H. (2021). Research on the Innovation and Reform of Art Education and Teaching in the Era of Big Data. *Advances in Intelligent Systems and Computing*, *1343*. https://doi.org/10.1007/978-3-030-69999-4_100

Sun, H. T., & Zheng, Q. H. (2016). The core technology, application status and development trend of educational big data potential. *Journal of Distance Education*, *5*, 41–49. https://doi.org/10.15881/j.cnki.cn33-1304/g4.2016.05.004 [in Chinese]

Sun, J. J., Cheng, Y., & Ke, Q. (2007). Advances of Research on Technology - Acceptance Model. *Information Science*, *25*(8), 112–127 [in Chinese]

Swift, R. S. (2001). *Accelerating customer relationships: Using CRM and relationship technologies*. Prentice Hall Professional.

Tabachnick, B. G., Fidell, L. S., & Ullman, J. B. (2007). *Using multivariate statistics* (7th ed.). Pearson. https://www.pearsonhighered.com/assets/preface/0/1/3/4/0134790545.pdf

Tane, J., Schmitz, C., & Stumme, G. (2004). Semantic resource management for the web: an e-learning application. *Proceedings of the 13th International World Wide Web Conference on Alternate Track Papers & Posters*, 1–10. https://doi.org/10.1145/1013367.1013369

Tang, Y. K. (2013). *University Courses Online*. http://www.bjreview.com.cn/nation/txt/2013-11/18/content_578521.htm

Tao, X. J. (2013). Overview of big data research. *Journal of System Simulation*, *8*, 142–146 [in Chinese]

Taylor, S., & Todd, P. (1995a). Assessing IT usage: The role of prior experience. *MIS Quarterly*, *19*(4), 561–570. https://doi.org/10.2307/249633

Taylor, S., & Todd, P. (1995b). Decomposition and crossover effects in the theory of planned behavior: A study of consumer adoption intentions. *International Journal of Research in Marketing*, *12*(2), 137–155. https://doi.org/10.1016/0167-8116(94)00019-K

Teo, T. (2009). A case for using structural equation modelling (SEM) in educational technology research. *British Journal of Educational Technology*, *41*(5), E89–E91. https://doi.org/10.1111/j.1467-8535.2009.00999.x

Teo, T. (2010). A path analysis of pre-service teachers' attitudes to computer use: applying and extending the technology acceptance model in an educational context. *Interactive Learning Environments*, *18*(1), 65–79. https://doi.org/10.1080/10494820802231327

Teo, T. (2011). Factors influencing teachers' intention to use technology: Model development and test. *Computers & Education*, *57*(4), 2432–2440. https://doi.org/10.1016/j.compedu.2011.06.008

Teo, T., Lee, C. B., & Chai, C. S. (2008). Understanding pre- service teachers' computer attitudes: applying and extending the technology acceptance model. *Journal of Computer Assisted Learning*, *24*(2), 128–143. https://doi.org/10.1111/j.1365-2729.2007.00247.x

Teo, T., & Noyes, J. (2012). Explaining the intention to use technology among pre-service teachers: a multi-group analysis of the Unified Theory of Acceptance and Use of Technology. *Interactive Learning Environments*, *22*(1), 51–66. https://doi.org/10.1080/10494820.2011.641674

The State Council of the People's Republic of China. (2015). *Action Plan on Promoting Big Data Development*. http://www.gov.cn/zhengce/content/2015-09/05/content_10137.htm

The State Council of the People's Republic of China. (2021). *Int'l big data expo opens in southwest China*. http://english.scio.gov.cn/chinavoices/2021-05/27/content_77530104.htm

The Yunnan Network of ICT in Education. (2016). *Yunnan Provincial Department of Education and China Mobile Communications Corporation cooperate to promote education.* https://www.ict.edu.cn/p/yunnan/zxzx/n201609211719.html

The Yunnan Network of ICT in Education. (2018). *Yunnan: information construction to help education targeted poverty alleviation.* https://www.ict.edu.cn/p/yunnan/zxzx/n2018011611378.html

Thomas, B. (2018). *Big Data in Education: Researchers' Responsibilities*. https://www.qi-partners.com/2018-6-5-big-data-in-education-researchers-responsibilities/

Thompson, R. L., Higgins, C. A., & Howell, J. M. (1991). *Personal computing: Toward a conceptual model of utilization.* MIS quarterly.

Thu Pham, T. B., Dang, L. A., Hue Le, T. M., & Le, T. H. (2020). Factors affecting teachers' behavioral intention of using information technology in lecturing-economic universities. In *Management Science Letters* (Vol. 10, Issue 11, pp. 2665–2672). https://doi.org/10.5267/j.msl.2020.3.026

Tian, J., & Xia, Z. (2017, April). MOOCs in China's universities: Practice, characteristics and trends. In *2017 3rd International Conference on Information Management (ICIM)* (pp. 378-382). IEEE.

Tian, J., & Zheng, Z. (2017, June). Smart education in Yunnan, China: Present situation and construction measures. In *2017 International Conference on Service Systems and Service Management* (pp. 1-5). IEEE.

Tian, Y. H. (2015). Research and Practice of the Hybrid Cloud Storage in Colleges and Universities. *Computer Knowledge and Technology*, *11*(26), 35–38 [in Chinese]

Trcka, N., Pechenizkiy, M., & van der Aalst, W. (2010). *Handbook of educational data mining* (pp. 123–142). CRC Press.

Uddin, M. F., & Gupta, N. (2014). Seven V's of Big Data understanding Big Data to extract value. *Proceedings of the 2014 Zone 1 Conference of the American Society for Engineering Education*, 1–5. https://ieeexplore.ieee.org/abstract/document/6820689/

Ueno, M. (2004). Online outlier detection system for learning time data in E-learning and It's evaluation. *Proc. of Computers and Advanced Technology in Education*. https://www.researchgate.net/publication/220942736

Vail, A. K., Grafsgaard, J. F., Wiggins, J. B., Lester, J. C., & Boyer, K. E. (2014, November). Predicting learning and engagement in tutorial dialogue: A personality-based model. In *Proceedings of the 16th international conference on multimodal interaction* (pp. 255-262).

Van Barneveld, A., Arnold, K. E., & Campbell, J. P. (2012). Analytics in higher education: Establishing a common language. *EDUCAUSE Learning Initiative*, *1*(1), l–ll.

Venkatesh, V., & Davis, F. D. (2000). A theoretical extension of the technology acceptance model: Four longitudinal field studies. *Management Science*, *46*(2), 186–204. https://doi.org/10.1287/mnsc.46.2.186.11926

Venkatesh, V., Morris, M., Davis, G., Quarterly, F. D.-M., & 2003, U. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly*, *27*(3), 425–478. https://doi.org/https://doi.org/10.2307/30036540

Venkatesh, V., Thong, J. Y., & Xu, X. (2012). Consumer acceptance and use of information technology: extending the unified theory of acceptance and use of technology quarterly. *MIS Quarterly*, *36*(1), 157–178. https://doi.org/10.2307/41410412

Verma, S., Bhattacharyya, S. S., & Kumar, S. (2018). An extension of the technology acceptance model in the big data analytics system implementation environment. *Information Processing and Management*, *54*(5). https://doi.org/10.1016/j.ipm.2018.01.004

Vogt, W. P. (2007). *Quantitative research methods for professionals.* Allyn & Bacon Publishing.

Vorhies, B. (2013). *How Many "V"s in Big Data – The Characteristics that Define Big Data*. Data Mrgnum. http://data-magnum.com/how-many-vs-in-big-data-the-characteristics-that-define-big-data/

Waehama, W., Mcgrath, M., Korthaus, A., & Fong, M. (2014). ICT Adoption and the UTAUT Model. *Proceedings of the International Conference on Educational Technology with Information Technology*, *17*, 24–30. https://pdfs.semanticscholar.org/b6ce/9b07f64c749b6647a7cb81736b58d795f0e4.pdf

Waldrop, M. M. (2013). Online learning: campus 2.0. *Nature News*, *495*(7440), 160.

Wang, J., Chen, S. C., Wang, L. L., & Yang, X. M. (2016). The Analysis of Research Hot Spot and Trend on Big Data in Education based on CiteSpace. *Modern Educational Technology*, *26*(2), 5–13. https://doi.org/10.3969/j.issn.1009-8097.2016.02.001 [in Chinese]

Wang, L. L., Ye, Y., & Yang, X. M. (2016). Design of Online Learning Early-warning Model based on Big Data —— The Learning Early-warning of "Research and Practice Column about Big Data in Education." *Modern Educational Technology*, *26*(7), 5–11. https://doi.org/10.3969/j.issn.1009-8097.2016.07.001 [in Chinese]

Wang, M., & Shu, J. B. (2020). Research on SPOC teaching evaluation model based on big data of education. *The Chinese Journal of ICT in Education*, *3*, 74–79 [in Chinese]

Wang, S., Yang, Y., & Yang, H. (2015). Review on the Study of Ideological and Political Education Based on Big Data. *University Education Science*, *3*, 112–117 [in Chinese]

Wang, Y. (2020). A comprehensive evaluation system of teaching quality based on big data architecture. *International Journal of Continuing Engineering Education and Life Long Learning*, *30*(2), 176–189. https://doi.org/10.1504/IJCEELL.2020.106337

Wang, Y., & Wiebe, V. J. (2016). Big Data Analytics on the characteristic equilibrium of collective opinions in social networks. In *Big Data: Concepts, Methodologies, Tools, and Applications* (pp. 1403–1420). IGI Global.

Warner, R. M. (2012). *Applied statistics: From bivariate through multivariate techniques.* Sage Publications.

Wayman, J. C., Stringfield, S., & Yakimowski, M. (2004). *Software Enabling School Improvement through Analysis of Student Data*. http://www.waymandatause.com/wp-content/uploads/2013/11/Report67.pdf

Webb, M. B., Dowd, K., Harden, B. J., Landsverk, J., & Testa, M. (2010). *Child welfare and child well-being: New perspectives from the national survey of child and adolescent well-being.* Oxford University Press. https://doi.org/10.1093/acprof:oso/9780195398465.001.0001

Wei, S. P. (2015). Learning Analytics: Mining the Value of Education Data under the Big Data Era. *Modern Educational Technology*, *2*, 6–7. https://doi.org/10.3969/j.issn.1009-8097.2013.02.001 [in Chinese]

Wen, Y., Tian, Y., Wen, B., Zhou, Q., Cai, G., & Liu, S. (2020). Consideration of the local correlation of learning behaviors to predict dropouts from MOOCs. *Tsinghua Science and Technology*, *25*(3). https://doi.org/10.26599/TST.2019.9010013

West, D. M. (2012). Big Data for Education: Data Mining, Data Analytics, and Web Dashboards. *Governance Studies at Brookings*, *4*(1), 1–10.

Williams, P. (2002). The learning web: the development, implementation and evaluation of internet-based undergraduate materials for the teaching of key skills. *Active Learning in Higher Education*, *3*(1), 40–53. https://doi.org/10.1177/14697874020030010

Wise, A. F. (2019). Learning Analytics: Using Data-Informed Decision-Making to Improve Teaching and Learning. In *Adesope, O.O., Rud, A.G. (eds) Contemporary Technologies in Education* (pp. 119–143). Palgrave Macmillan, Cham. https://doi.org/10.1007/978-3-319-89680-9_7

Wong, M. (2020). *Online teaching: A prospective educational model*. http://global.chinadaily.com.cn/a/202004/21/WS5e9e9a10a3105d50a3d17be7.html

Workman, M. (2014). New media and the changing face of information technology use: The importance of task pursuit, social influence, and experience. *Computers in Human Behavior*, *31*, 111–117. https://doi.org/10.1016/j.chb.2013.10.008

Wright, M. C., McKay, T., Hershock, C., Miller, K., & Tritz, J. (2014). Better than expected: Using learning analytics to promote student success in gateway science. *Change: The Magazine of Higher Learning*, *46*(1), 28–34. https://doi.org/10.1080/00091383.2014.867209

Wu, D., Lu, J., & Zhang, G. (2015). A fuzzy tree matching-based personalized e-learning recommender system. *IEEE Transactions on Fuzzy Systems*, *23*(6), 2412–2426. https://doi.org/10.1109/TFUZZ.2015.2426201

Wu, J. Y. (2019). Based on big data in education Research on personalized adaptive learning service-- a case study of Anhui radio and television university. *Journal of Guangxi Normal University for Nationalities*, *3*(36), 77–80. https://doi.org/10.19488/j.cnki.45-1378/g4.2019.03.020 [in Chinese]

Xiao, L. (2020). Exploration on the Innovative Development of Vocational Education in the Era of Educational Informationization 2.0. *Education and Vocation*, *8*, 34–40. https://doi.org/10.13615/j.cnki.1004-3985.2020.08.005 [in Chinese]

Xing, B. B., Yang, X. M., & Li, Q. S. (2016). The source and collection technology of educational big data. *Modern Educational Technology*, *26*(8), 14–21. https://doi.org/10.3969/j.issn.1009-8097.2016.08.002 [in Chinese]

Xing, W., & Goggins, S. (2015, March). Learning analytics in outer space: a Hidden Naïve Bayes model for automatic student off-task behavior detection. In *Proceedings of the Fifth International Conference on learning analytics and knowledge* (pp. 176-183).

Xing, W., Guo, R., Petakovic, E., & Goggins, S. (2015). Participation-based student final performance prediction model through interpretable Genetic Programming: Integrating learning analytics, educational data mining and theory. *Computers in Human Behavior*, *47*, 168–181. https://doi.org/10.1016/j.chb.2014.09.034

Xu, D. M. (2019). *Teaching behavior analysis based on campus data* [Master's Dissertation, Shandong Normal University]. CNKI. https://wap.cnki.net/touch/web/Dissertation/Article/10445-1019118649.nh.html [in Chinese]

Xu, P., Wang, Y. N., Liu, Y. H., & Zhang, H. (2013). The Lear ning Innovation fr om the Per spective of Big Data: An Analysis of the U.S. Report of Enhancing Teaching and Learning through Educational Data Mining and Learning Analytics and Its Enlightenment. *Journal of Distance Education*, *31*(06), 11–17. https://doi.org/10.15881/j.cnki.cn33-1304/g4.2013.06.008 [in Chinese]

Xu, R. (2017). Research on Personalized Adaptive Learning of College Students from the Perspective of Big Data. *Computer Knowledge and Technology*, *13*(31), 153–161. https://doi.org/10.14004/j.cnki.ckt.20171128.002 [in Chinese]

Yadav, S. K., & Pal, S. (2012). Data mining: A prediction for performance improvement of engineering students using classification. *World of Computer Science and Information Technology Journal WCSIT*, *2*(2), 51–56. https://doi.org/10.48550/arXiv.1203.3832

Yang, B., Yao, Z., Lu, H., Zhou, Y., & Xu, J. (2020). In-classroom learning analytics based on student behavior, topic and teaching characteristic mining. *Pattern Recognition Letters*, *129*, 224–231. https://doi.org/10.1016/j.patrec.2019.11.023

Yang, Y. L., Zhang, S. R., Ding, D., Zhang, H., & Wang, N. (2014). Using Big Data in the Teaching of English Writing in the MOOC and SPOC Era. *Modern Educational Technology*, *24*(12), 45–51. https://doi.org/10.3969/j.issn.1009-8097.2014.12.006 [in Chinese]

Yao, D. L. (2017). Influence of big data on nursing teaching research in universities. *Nursing Research*, *31*(22), 2811–2813. https://doi.org/10.3969/j.issn.1009-6493.2017.22.039 [in Chinese]

Yeow, P. H., Loo, W. H., & Sketch, S. B. (2019). Factors affecting the user acceptance of Malaysia's e-government smart national identity card (Mykad). *Government Information Quartely*, *26*(2), 358–367. https://doi.org/10.1016/j.giq.2008.07.004

Yi, Z., Nie, H., Dong, C., Jiang, J., Su, F., Wang, Z., & Zeng, H. (2021). Big Data and Data Science Education in Traditional Chinese Medicine Informatics: Challenges and Opportunities. *American Journal of Information Science and Technology*, *5*(4), 109–113. https://doi.org/10.11648/j.ajist.20210504.15

Yoo, S., Han, S., Behavior, W. H.-C. in H., & 2012, U. (2012). The roles of intrinsic motivators and extrinsic motivators in promoting e-learning in the workplace: A case from South Korea. *Computers in Human Behavior*, *28*(3), 942–950. https://doi.org/10.1016/j.chb.2011.12.015

Youshan, Z., Shaozhe, G., Yong, L., Kaikai, Y., & Qiming, L. (2021, August). Research Hotspots and Trend Analysis of Big Data in Education. In *2021 International Conference on Big Data Engineering and Education (BDEE)* (pp. 110-114). IEEE.

Youtie, J., Porter, A. L., & Huang, Y. (2017). Early social science research about Big Data. *Science and Public Policy*, *44*(1), 65–74. https://doi.org/10.1093/scipol/scw021

Yu, C. S. (2012). Factors affecting individuals to adopt mobile banking: Empirical evidence from the utaut model. *Journal of Electronic Commerce Research*, *13*(2), 104–121.

Yu, X., & Wu, S. (2015, October). Typical applications of big data in education. In *2015 International Conference of Educational Innovation through Technology (EITT)* (pp. 103-106). IEEE.

Yuan, Y. X., & Guo, X. Z. (2017). Research on efficient classification and storage technology of mass data in educational multimedia. *Modern Electronics Technique*, *40*(8), 42–45. https://doi.org/10.16652/j.issn.1004- 373x.2017.08.013 [in Chinese]

Yukselturk, E., Ozekes, S., & Türel, Y. K. (2014). Predicting Dropout Student: An Application of Data Mining Methods in an Online Education Program. *European Journal of Open, Distance and E-Learning*, *17*(1), 118–133. https://doi.org/10.2478/eurodl-2014-0008

Yunnan Province Education Department. (2019). *Conference on educational informatization in Yunnan province*. https://jyt.yn.gov.cn/web/38d5f8d6af024bd0abe28cc484b18af0/b01853768bd640038363a264f5ac9cef.html

Yurdakul, I. K., Ursavaş, Ö. F., & İŞÇİTÜRK, G. B. (2014). An integrated approach for preservice teachers' acceptance and use of technology: UTAUT-PST Scale. *Eurasian Journal of Educational Research*, *55*, 21–36. https://doi.org/10.14689/ejer.2014.55.2

Zhang, D. (2018, October). Big data security and privacy protection. In *8th international conference on management and computer science (ICMCS 2018)* (Vol. 77, pp. 275-278). Atlantis Press.

Zhang, K. (2018). Theory of Planned Behavior: Origins, Development and Future Direction. *International Journal of Humanities and Social Science Invention*, *7*(5), 76–83. http://www.ijhssi.org/papers/vol7(5)/Version-4/K0705047683.pdf

Zhang, P. G., Zhang, S., & Li, X. X. (2015). Comprehensive evaluation of education quality based on big data. *China Education Information*, *5*, 12–14 [in Chinese]

Zhang, T., Elizabeth, C., & Cao, R. (2020). Application of Big Data Research: A Comparison of China and US. In *Lecture Notes in Computer Science* (Vol. 12411, pp. 28–42). Springer. https://doi.org/https://doi.org/10.1007/978-3-030-59595-1_3

Zhang, W., & Qin, S. (2018, March). A brief analysis of the key technologies and applications of educational data mining on online learning platform. In *2018 IEEE 3rd International Conference on Big Data Analysis (ICBDA)* (pp. 83-86). IEEE.

Zhang, Y. (2022). Challenges and Strategies of Student Management in Universities in the Context of Big Data. *Mobile Information Systems*, *2022*. https://doi.org/10.1155/2022/3537468

Zhang, Y. Q. (2000). *Reflection and construction of higher education modernization*. Heilongjiang education press.

Zhao, J. Y., & Hu, Z. B. (2016). Research on the Informative Teaching Mode of University under the Environment of Big Data. *Information Science*, *34*(1), 92–103. https://doi.org/10.13833/j.cnki.is.2016.01.018 [in Chinese]

Zhao, L., & Huang, C. L. (2014). Key Technologies in Practical Speech Emotion Recognition. *Journal of Data Acquisition and Processing*, *29*(2), 157–170.

Zhao, Y., Miao, T., & Liu, J. (2020). Exploration and Research of Feynman Learning Method in Higher Education Teaching Reform. *International Journal of Education and Economics*, *3*(1), 99–103.

Zhou, M. (2016). Chinese university students' acceptance of MOOCs: A self-determination perspective. *Computers & Education*, *92*, 194–203. https://doi.org/10.1016/j.compedu.2015.10.012

Zhou, R. (2019). Implement the digital Yunnan strategic deployment to promote the construction of smart education. In *Yunnan Province Education Department*. https://jyt.yn.gov.cn/web/28300/39f2ca7f34c442ee9264fc41461c7de4.html

Zhu, J. P., & Li, Q. Y. (2014). The impact of big data on university teaching. *University Teaching in China*, *9*, 41–44. https://core.ac.uk/download/pdf/41448917.pdf [in Chinese]

Zhu, L. (2013). Distributed Campus Video Surveillance System Design Based on Cloud Computing. *Computer Measurement and Control*, *21*(10), 2676–2679. https://doi.org/10.16526/j.cnki.11-4762/tp.2013.10.084 [in Chinese]

Zhu, X., Ye, Y., Zhao, L., & Shen, C. (2021). MOOC Behavior Analysis and Academic Performance Prediction Based on Entropy. *Sensors*, *21*(19), 6629. https://doi.org/10.3390/s21196629

Zhuo, W. X., Yang, C., & Li, H. Y. (2019). Big Data and Educational Intelligence: A Summary of the 17th International Forum on Educational Technology. *Research on Lifelong Education*, *30*(3), 62–67. https://doi.org/10.13425/j.cnki.jjou.2019.03.010 [in Chinese]