

## Editorial

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### Hongjiang Wang\*

School of Education Information Technology,  
South China Normal University,  
No. 55, West of Zhongshan Avenue,  
Tianhe District, Guangzhou, 510631, China  
Email: wanghongjiang@m.scnu.edu.cn

\*Corresponding author

### Yangli Liang

School of Educational Science and Technology,  
Nanjing University of Posts and Telecommunications,  
9 Wenyuan Street, Qixia District, Nanjiang, 210023, China  
Email: lyl@njupt.edu.cn

### Qiyun Wang

Learning Sciences and Technologies Academic Group,  
National Institute of Education,  
Nanyang Technological University,  
1 Nanyang Walk, 637616, Singapore  
Email: qiyun.wang@nie.edu.sg

**Biographical notes:** Hongjiang Wang is an Associate Researcher at the School of Education Information Technology, South China Normal University, China. His research interests include online learning, intelligent learning, application of artificial intelligence in education and learning behaviour analysis.

Yangli Liang is an Associate Professor at the School of Educational Science and Technology, Nanjing University of Posts and Telecommunications, China. Her research interests include online learning, intelligent learning, application of artificial intelligence in education and learning behaviour analysis.

Qiyun Wang is an Associate Professor in the Academic Group of Learning Science and Technologies at National Institute of Education, Nanyang Technological University, Singapore. His research interests include online learning, Web 2.0 tools, web-based learning environment design and interactive learning.

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## 1 Introduction

Online learning has become a commonly adopted way of learning in the digital society. Many research studies have been done for improving the engagement level and learning results of students in the online learning environment. With the development of big data technologies and artificial intelligence, an increasing amount of attention has been paid to online learning behaviour analysis, as online learning behaviour is often considered as a predictor of students' learning performance.

In this special issue of research on online learning behaviours, 11 academic papers are included. These papers cover learning behaviour data acquisition and analysis, data process methods, blended teaching or learning system design, and evaluation on learning outcomes.

## 2 An overview of the papers

The first four papers, written by M. Liu, S. Shen and C. Chen, X. Wang, S. Mu, D. Tang, H. Wen, Y. Zhou and J. Dong, X. Huang, X. Wang and F. Liu and J. Jia separately, are about analysing the learning behaviour data in online learning platform. The former two focus on learning materials design methods based on the analysis of online learning behaviour data. The latter two mainly discuss learning behaviour classing and learners' learning weakness analysis.

In the paper about analysis of the learners' learning behaviours in MOOC informationisation leadership, Liu et al. using data mining technology to mine the informationisation leadership learning behaviours from five dimensions. They found that the learners were mainly composed of principals, middle-level educational managers and key teachers. The learner's general learning behaviour characteristics were mainly expressed by the facts that the learner's interest in practical cases, and few participants can last more than four weeks, and the learners like videos and texts. According to the learning behaviour, the learners can be divided into three clusters. The value of MOOC should not be evaluated on the base of certification rates but on whether the learner's learning needs were met.

The paper written by Wang et al. is about to how to design and develop high-quality online learning materials for efficiently conveying information and optimising teaching effect. To determine the different learning effect of with and without an instructor, they selected three types of data: test data, eye movement data and questionnaire and interview data. They found that instructors had no significant impact on learners' conceptual learning grades of declarative knowledge; there was no significant difference in learners' performance of viewing area, but there was a difference in their performance of teachers area; through comprehensive questionnaire and interview data analysis, there was no significant difference in learners' learning experience of conceptual learning in declarative knowledge video with and without an instructor. This study provides a reference for designing and developing online video lectures. When designing the video lectures of conceptual learning, it can adopt instructor-free way considering saving time and cost.

In the paper about evaluating learners' online learning behaviour based on analytic hierarchy process (AHP), Huang et al. analysed the online learning behaviour data from the 'Moso Teach' cloud platform by correlation analysis, cluster analysis and AHP

analysis. They found that the problem-solving behaviour of learner was generally low; social interaction behaviour was better than problem-solving behaviour, at last was resource learning behaviour; The curve of the score distribution diagram of resource learning behaviour showed an inverse 'S' shape, while the curve of the score distribution diagram of social interaction behaviour and problem solving behaviour was close to a straight line. There were gender differences in resource learning behaviour, learning achievement differences in resource learning behaviour and problem-solving behaviour, and core-marginal differences in resource learning behaviour and social interaction behaviour.

In the paper about studies on e-learning behaviours of undergraduates, Jia collected students' e-learning behaviour data during the learning process in the course cross-cultural communications. He found that there was strong utilitarian element and weak interactivity with e-learning. Students lacked the awareness of reflective learning. There was significant difference in learning hours among students, with a considerable portion of the hours being allocated to homework. Content of courses on the e-teaching platform was not pertinent.

The following two papers, written by H. Yu and Q. Wang separately, are about designing the blended teaching or learning system.

The paper written by Yu is about research on curriculum construction and application in colleges under blended learning. He collected and analysed data on the development and application of 281 blended teaching reform courses of a college. He found that the reform of blended teaching had improved students' motivation and ability to learn, and students' cognition. Moreover, for some problems, such as insufficient teaching video resources and monotonous teaching methods, he proposed two recommendations on the development and application of school-based college courses in the context of blended learning, namely strengthening the development of video resources for these blended teaching courses and enhancing teachers' capability of blended teaching.

The paper written by Wang is about designing and implementing the blended synchronous learning (BSL) from the pedagogical, social, technical and managerial aspects. He presented how BSL was prepared and designed before a lesson, implemented during the lesson, and improved after the lesson from the instructor's perspective. He found that the instructor needed to adjust certain learning activities before a lesson, who was often cognitively overloaded and having difficulties in monitoring the participation and engagement of the online students during the lesson.

The following four papers, written by S. Li, R. Wang, X. Li and T. Zhou and X. Chen, W. Li and Y. Jiang, are about designing the prediction system of learners' learning performance based on the learners' learning behaviour data using different data processing algorithms.

The paper written by Li is about solving the problem that teachers cannot monitor learners' learning behaviour or evaluate learners' learning objectively and scientifically because of the relative separation of time and space between teachers and students. He proposed a Bayesian network learning evaluation model based on knowledge relationship. He found that the proposed model could accurately judge the degree of students' mastery of knowledge, and could provide students with personalised guidance strategy.

In the paper about analysing the learning patterns and behaviour data of learners' online learning in a cloud computing environment, Wang studied the learners' learning progress, learning rules, and learning effects through data mining algorithms to

promote learners' self-learning consciousness and self-learning ability and achieve the learner-centred application goal. He randomly selected eight learners as research subjects, and analysed their online learning behaviour through data mining algorithms, and finally realised personalised recommendation of learning content based on data mining results. He found that through the data mining algorithm to analyse the learning behaviour of online learners, the learners' learning state and learning effect can be intuitively understood, and the individual's learning behaviour characteristics can be roughly defined, then guiding suggestions can be given to help them complete learning goals and improve learning efficiency.

The paper written by Li and Zhou is about to design an academic warning system to identify students with abnormal learning behaviours, to give early warning of students' learning status, and to help students successfully complete their studies. They took the comprehensive academic performance of university students as the research object, and collected the basic information data, academic performance data and online data. They constructed an online learning warning system. They found that the online learning early warning system can make it easier for students and teachers to understand the reasons for learning abnormalities and the correlation between different behaviours and academic performance, so as to make corresponding improvements.

In the paper about analysing learners' behaviour data stored on the online learning platform using the K-means clustering algorithm, Chen et al. explored the learning behaviour data, basic information, and user types and factors affecting performance of online learning learners. They proposed a K-means feature selection algorithm and an equilibrium discriminant function. At last, they found that the performance prediction model proposed had high prediction accuracy for online learners' performance.

In the last paper about adaptive optimisation algorithm for online teaching behaviour, J. Zhu employed two mechanisms to optimise the weakness of teaching learning-based optimisation algorithm. He found that by setting-up multiple teachers to teach in the TLBO algorithm, the diverse nature of the population could be preserved. Teachers could also explore and learn from each other and students could improve their learning efficiency. The algorithm was improved in the precision of optimisation and the weakness of local optimisation.

### **3 Summary**

This special issue is a collection of research studies that relate to online learning behaviours analysis. It covers various topic such as learning behaviour classing, data acquisition and analysis, and evaluation on learning outcomes. It reports some conceptual papers, case studies, and literature reviews about how to design resources, evaluate learning effect, and analyse learner characteristics based on learning behaviour analysis. It also includes papers that describe the algorithms design of assessment of learners' learning behaviour, and blended teaching or learning system. We hope that this special issue will be particularly useful for researcher and practitioners who are interested in online learning design and evaluation of online learning behaviour.