The Impact of E-learning Ability on Online Learning Engagement and Learning Performance among College Students in Guangzhou

Yang Lihua, Wei Hui-Suan, Ch'ng Lay Kee and Mohd Ridzuan Darun

Abstract –**Purpose of the investigation is to explore the relation of E-learning abilities upon learning engagement and learning performances, for that study will choose explanatory sequential method to collect primary data through self-administered 5-likert scale questionnaire. Study will be conducted on independent and dependent paradigm. Construct will be derived from theoretical framework of E-learning theory is built on cognitive science principles that demonstrate how the use and design of educational technology can enhance effective learning (David, 2015; Wang 2012). The theory was developed from a set of principles created based on Cognitive Load Theory (Sweller, Van Merriënboer & Paas, 2019). Biggs' "Learning presage - Learning process - Learning product" will also be considered as framework to analyse the engagement and performances of the students in colleges of Guangzhou. Study will use mean ratings, weighted means to rank and rate the answers of the participants. Slovin's formula will be adopted to calculate sample size from 10 colleges of Guangzhou. After acquiring sample size study will make the clusters to apply random probability method. Once sampling is done, data collection process will be started considering all ethical requirements and protocol of the college. Data will be collected online due to Covid-19 restriction with email addresses provided. Before collecting data reliability analysis and validity of the questionnaire will have assured. Study will apply regression analysis and correlation analysis to explore the impact and relationship bond between E-learning Ability, Online Learning Engagement and Learning Performance. T-test, P-value and Kurtosis will test the validity of study hypotheses and rejection of null hypotheses. Interpretations of descriptive analysis will be based on the mean ratings. General statement of problem is to assess the significant differences between E-learning Ability, Online Learning Engagement and Learning Performance**

Keywords – **E-learning ability, online learning engagement, learning performance, E-learning**

I. INTRODUCTION

E-learning has emerged in the field of education, based on previous studies, for a more in-depth analysis of E-learning ability, the relationship between the engagement in online learning and online learning performance provides the foundation, adopts the method of quantitative analysis of online education, online learning ability of college students' E-learning in investment and will be the study of the

Yang Lihua, Guangdong Polytechnic of Science and Technology & City University of Malaysia, China (Email address: 78071903@qq.com).

Wei Hui-Suan, City University of Malaysia, Malaysia (Email address: wei.hui@city.edu.my).

CH'NG LAY KEE, City University of Malaysia, Malaysia (Email address: chng.lay @city.edu.my).

Mohd Ridzuan Darun, City University of Malaysia, Malaysia (Email address: ridzuan.darun @city.edu.my).

performance of online learning, to a certain extent. Theoretical research on E-learning ability, online learning engagement and online learning performance has been enriched and developed, providing another research idea for the study of online learning performance. The study is based on Biggs' "presage - process - product" learning analysis framework, aims to explore the relationship between college students' E-learning ability, online learning engagement and online learning performance.

The study adopts the method of empirical research. First of all, read, summarize, analyse and research literature to master the research status of relevant research fields. Then, a questionnaire survey is conducted among college students who participate in online course learning. Finally, SPSS and AMOS will be used to test the measurement scale, research hypothesis and theoretical model, followed by questionnaire item analysis, exploratory factor analysis, reliability and validity analysis, descriptive statistical analysis, correlation analysis, regression analysis, and mediation effect test. On the one hand, college students will have a certain understanding of their E-learning ability, online learning engagement and online learning performance. On the other hand, it provides direction and guidance on how to improve the quality of online learning for college students.

As a preparatory factor of learners, E-learning ability has a particularly important impact on the process and results of online learning. However, there are few studies on the specific relationship between the elements in the stage of sexual exploration from the perspective of the whole process of online learning. Therefore, based on Biggs' 3P learning analysis framework, this study investigates the specific relationship among college students' E-learning ability, online learning engagement and learning performance, in order to provide new research reference for improving the quality of online learning for college students.

The study explores the structure and effect relationship among college students' E-learning ability, online learning engagement and online learning performance. On the one hand, college students will have a certain understanding of their E-learning ability, online learning engagement and online learning performance. On the other hand, it provides direction and guidance on how to improve the quality of online learning for college students.

II. PROBLEM STATEMENT

With the gradual and in-depth integration of Internet technology in the field of education, the concept of higher education has changed completely, and the change of college students' learning mode has become an irreversible trend. In order to cope with the new educational transformation

brought by "Internet + education", college students must improve their digital learning ability so that they can obtain useful resources from a large number of learning resources. Centring on the theme of "Analysis and Evaluation of online learning", the study empirically investigates the interaction among college students' digital learning ability, online learning engagement and online learning performance, so as to provide reference for improving online teaching practice and further enrich college students' understanding of online learning rules.

The study aims to explore the relationship between learners' E-learning ability, online learning engagement and online learning performance. The research mainly focuses on the influence of E-learning ability on online learning engagement, the influence of E-learning ability on online learning performance, the influence of online learning engagement on online learning performance, and the mediating role of online learning engagement between E-learning ability and online learning performance.

Starting from the whole process of online learning, empirical analysis of the three stages of learning preparation, learning process and learning outcome of the specific impact of the relationship between the factors are few. Therefore, based on Biggs' "Presage - Process - Product" learning analysis framework, this study adopts statistical analysis method to quantitatively explore the specific influence relationship among college students' E-learning ability, online learning engagement and online learning performance.

Based on the online learning environment and the emerging learning mode, how to obtain good learning results, especially long-term learning results, is worth studying. Therefore, based on the development of online learning in reality and the research conducted by researchers in the theoretical background, this study intends to explore the following questions:

(1) Will college students' E-learning ability significantly affect online learning engagement?

(2) Will college students' E-learning ability significantly affect online learning performance?

(3) What is the relationship between online learning engagement and online learning performance of college students?

(4) Is there a partial or complete mediating effect between online learning engagement and the influence of E-learning ability on online learning performance?

So, the problem is that:

What Influence of E-learning Ability on Online Learning Engagement and Learning Performance among College Students in Guangzhou?

III.   LITERATURE REVIEW

Research on E-learning ability

Yang Huaijin (2018) for higher vocational students as the research object, adopt the method of questionnaire investigation about the present situation of higher vocational students' ability to E-learning is studied, results show that the students to use information technology to promote the consciousness of learning and enrich learning resources is

low, lack of different format information retrieval ability and cannot afford to own a reasonable evaluation on the learning process.

Luo Zhaobi (2018) to the cultivation of high school students E-learning ability as the main research contents, select a senior high school students of chengdu as the research object, based on PBL in the implementation framework of E-learning ability training, and teaching experiments to verify whether this framework can effectively promote the cultivation of high school mathematical learning ability, The results show that the implementation framework is effective in cultivating the E-learning ability of senior high school students.

Zhuang Rongxia (2018) constructed a 4-dimensional and 7-factor model of E-learning ability of primary and secondary school students from the perspective of lifelong learning. The four dimensions are mainly composed of cognitive processing, information literacy, learning intention management and learning behavior management, while the seven elements are mainly composed of cognitive processing, text reading, rich media integration, intention management, task management, partner management and time management.

Yang Yue (2019) studied the status quo of college students' E-learning ability, and the results showed that the overall level of college students' E-learning ability was above average in a statistical sense.

He Qindeng (2020) in the study points out that the E-learning ability is one of the core competence of college students for the new age, and college students of administration in a university as the research object, the present situation of the E-learning ability for college students has carried on the empirical investigation, the results show that the E-learning ability of students is average level as a whole, but active learning consciousness is weak, Lack of behavior ability and management ability in the process of learning, lack of self-learning effect evaluation problems still exist.

Luo Fang (2020) pointed out that the core accomplishment in the research of background, how to develop the students' ability of E-learning is very important, therefore from building network teaching platform, design the network information investigation tasks and the use of mobile communication optimization online tutoring and so on three aspects to explore digital to effectively foster students' ability to learn how to do it.

Research on online learning engagement

Yin Rui (2017) established theoretical models of behavioral investment, cognitive investment, emotional investment and social interaction investment based on the existing research results of online learning investment, and analyzed the relationships and effects of various dimensions of the model with 662 college students in Guangdong Province as research objects by adopting structural equation model. The analysis results show that the influence of each dimension of online learning engagement on overall online learning engagement is ranked from high to low as social interaction, cognition, emotion and behavior.

Jiang Qiang (2018) pointed out in their research that teachers are an important factor in improving learners' online learning engagement, and teacher motivation plays a key role in learners' learning motivation, thus making learners' deep involvement possible. Therefore, the structural equation model is used to analyze the data of students who participate in the online learning space course. The results show that the self-supporting teacher motivation has a positive impact on online learning engagement, while the controlling teacher motivation has no significant impact on online learning engagement.

From the perspective of learning motivation and self-regulation, Huang Qingshuang (2019) took 308 students from 7 universities in Liaoning Province as the research objects and adopted the structural equation method to study the related issues of influencing factors of online learning engagement. The results showed that achievement goal orientation had a direct impact on online learning engagement. It can also have an indirect impact on online learning engagement through academic procrastination.

Xiao-yong hu (2020) from the Angle of view of the whole process of online learning, to participate in online learning of 293 college students as the research object, by using the method of structural equation modeling for online learning into the relevant problems affecting factors were studied, results show that the online learner's information literacy in direct positive impact on online learning.

Zhen-hua li (2020) from the test online learners in advance to ensure that the online learning this purpose, to build a online learning into automated assessment model, through online learning generated in the process of video images and mouse flow data, application of neural network algorithm to evaluate online learners inputs such as level, Finally, the results of the model are verified by experiments, and the results show that the model is feasible and effective for the evaluation of online learning engagement.

Research on online learning performance

Gong Yi (2018) in an online learning platform, such as 8822 learners as the research object, using machine learning algorithms for learners to produce a large number of learning behavior data analysis, empirically explored the relationship between online learning and online learning performance, the results show that investment in online learning and online learning performance is not completely were positively correlated, Only 60% of learners' online learning engagement is positively correlated with their online learning performance.

Mei Hong (2019) pointed out in their study that current MOOC education has problems of poor learning continuity and low completion rate. Based on TAM et al. 's relevant theories, they took undergraduates who took and completed one-semester MOOC courses in a university in Xi 'an as the research objects and used statistical software to analyze the collected questionnaire data. The results show that the usefulness of MOOC significantly affects online learning performance.

Cai Ruirui etc. (2019) of the performance evaluation of network learning environment related content was studied, based on the analysis of the key factors affect online learning performance, set up the performance evaluation system for the study, from the network learning behavior improvement, satisfaction and learning result of three dimensions of online learners' performance to carry on the effective and scientific evaluation.

Li shuang etc. (2020) from the perspective of teachers, 32 online higher education of teachers and students as the research object, through Nvivo text coding and analysis of the interviews collected, we empirically examine the online teacher teaching into effect on the performance of online learning, the results show that the teaching input is the main factor that influences the performance of online learning, Teaching design and teacher-student interaction are the most concerned factors affecting online learning performance.

E-learning has changed the space-time concept of learning. With the global sharing of E-learning resources, the emergence of virtual classrooms and virtual schools, and the rise of modern distance education, learning is not limited to schools and families. People can study in digital virtual schools through the Internet anytime and anywhere. In terms of time, you can't acquire enough knowledge and skills for a lifetime through one period of intensive study. Human beings will shift from one-off education to lifelong learning. Therefore, E-learning requires learners to have a lifelong learning attitude and ability. In the information age, individual learning will be lifelong. Individual lifelong learning refers to the process in which learners determine the goal of continuing learning according to the needs of society and work, and consciously plan, manage and make efforts to achieve the learning goal through various ways. Of course, this requires education to carry out profound changes, that is, the connotation and function of education, training objectives, contents and ways to provide conditions for people's lifelong learning.

At the same time, E-learning requires learners to have good information literacy. Only by cultivating students with good information literacy can they understand the knowledge brought by information and form their own views and knowledge structure. Information literacy is also a major characteristic of lifelong learners. In my opinion, information literacy consists of three basic points: basic information technology knowledge and application skills, which refers to the skills of information acquisition, processing and communication by using information technology; The contents of the information analysis, judgment and understanding ability, namely the information retrieval strategy, by use of the information source, the information content can be individually assessed, before receiving information, will think seriously about the validity of the information, the accuracy of the information statement, logical contradictions in identifying information reasoning or fallacy, determine the adequacy of the argument; The attitude and ability to integrate information, create information and use information according to social needs to integrate into the information society means that information users should have a strong sense of social responsibility, have a good spirit of cooperation with others, and regard information integration and creativity as a force to promote social progress.
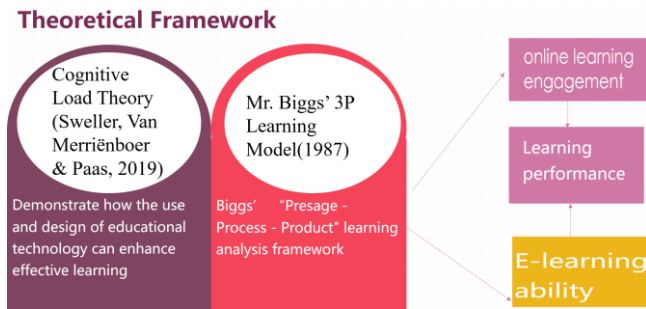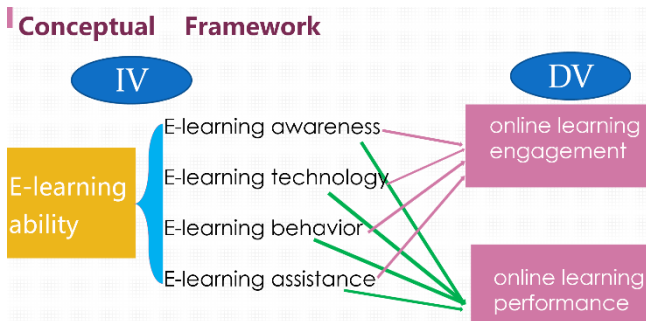
Figure 1. Theoretical Framework

Figure 2. Conceptual Framework

IV. METHOD

Research approach

Research methods are the specific research methods adopted in research. Based on the problems to be solved in this study and the research experience of existing achievements, the following three research methods are mainly adopted in this study:

(1) Literature research

This paper obtains a lot of materials related to research through network resources and library collections. To read the literature summary and the analysis and research, master the related research in the field of research situation, determine the research of the "E-learning", "E-learning ability", "online learning into" and "online learning performance," the core concept, clarify the basic research train of thought, lay a solid foundation for the research of this paper.

(2) Questionnaire survey

Questionnaire survey is a common method to obtain data information in statistics. It is a method to collect reliable information by designing questions and making questionnaires according to the purpose of the survey and sending them to the corresponding respondents to fill in.In this study, according to the college students' E-learning ability, the performance of online learning and online learning has both literature and develop the college students' online learning questionnaire as a research tool, and with snowball sampling method based on a questionnaire star research platform to participate in the online survey of college students learning the course.

(3) Empirical research method

After get the data from questionnaire survey, using SPSS and AMOS to measuring scale, research hypothesis

and theoretical model, has conducted questionnaire item analysis, exploratory factor analysis, letter validity analysis, descriptive statistics analysis, correlation analysis, regression analysis and the mediation effect of test data analysis methods, such as, provide data support to the research conclusion of this paper.

The paper adopts the research methods mentioned above to carry out the research, and the specific steps are as follows:

(1) Obtain literature and materials related to the study's E-learning ability, online learning engagement and online learning performance from network resources and library collections, and complete the research on relevant theoretical content;

(2) On the basis of literature research, develop the scale of college students' E-learning ability, online learning engagement and online learning performance;

(3) Questionnaires were issued for predictive test, item analysis, exploratory factor analysis and reliability and validity analysis were conducted on the questionnaires, and some questions were deleted and modified according to the evaluation criteria to form a formal questionnaire;

(4) Issuing formal questionnaires to collect research data. E-learning ability for college students through the data analysis, the current situation of online learning and online learning performance have a preliminary understanding of, and analysis on the gender, professional, and participate in online courses on three aspects, the number of college students' ability of E-learning, online learning and online learning performance if there is a difference;

(5) SPSS and AMOS will be used to analyse the correlation between E-learning ability, online learning engagement and online learning performance;

(6) Regression analysis was used to find the influence of E-learning ability on online learning engagement and online learning performance, and SPSS Bootstrap method was used to test the mediating effect of online learning engagement.

Population and Sampling

About 10 colleges in Guangzhou will be chosen for the questionnaire survey which include undergraduate and junior college students. Its purpose is to understand the status quo of college students' E-learning ability, online learning participation and online learning performance, as well as the relationship between E-learning ability, online learning participation and online learning performance. Through the analysis of the survey results, the regression model of E-learning ability to predict online learning participation is obtained, and the corresponding suggestions are put forward to improve the E-learning ability of college students.

From the purpose of the survey, survey includes freshmen, sophomores, juniors and seniors. Considering the convenience degree of the questionnaire distributed and issuing of the rationality of the object, the survey choose some key universities in Guangzhou, some specialist schools in general universities and a questionnaire in the form of electronic questionnaires, respondents from both pairs of first-class, a key university, also has from the ordinary

undergraduate course colleges and universities and colleges; Have already science and technology kind, teacher kind, also have agriculture and forestry kind. This makes the survey subjects more representative.

Simple Radom sampling is used in study, formed the questionnaire of Online Learning for College Students, which contains three scales, namely, E-learning Ability Scale, Online Learning Engagement Scale and Online Learning Performance Scale. Snowball sampling method was adopted and questionnaires were distributed based on the questionnaire star research platform. On the basis of the existing E-learning ability, online learning engagement and online learning performance related measurement scale tools, and combined with the actual needs of this paper, the "Online learning questionnaire for College Students" was developed. The following is a detailed introduction of each component of the questionnaire: The first part is the basic information of college students, with a total of three questions; The second part is the E-learning ability survey scale of college students, with a total of 20 questions; The third part is the online learning investment survey scale of college students, with 16 questions in total. The fourth part is the online learning performance survey scale for college students, with 11 questions in total. Likert 5-point scoring method was used to design each item of the three survey scales.

Data collection and instruments

The paper will use "SO JUMP" a professional online questionnaire platform）to collect data about E-learning awareness, E-learning technology application, E-learning behaviour, E-learning management, E-learning evaluation among college students in Guangzhou.

Composition of the questionnaire: The first part is the basic information of college students, a total of three questions; The second part is the E-learning ability survey scale of college students, with a total of 20 questions; The third part is the online learning investment survey scale of college students, with 16 questions in total. The fourth part is the online learning performance survey scale for college students, with 11 questions in total. Likert 5-point scoring method was used to design each item of the three survey scales.

V.   FINDINGS

As COVID-19 continues to spread around the world, its future is uncertain. Therefore, E-learning is expected to become an important way to solve the educational problems in the emergency period and even in the future. Drawing on data from E-learning around the world, the 2020 State of E-learning report focuses on the challenges and priorities facing teachers and administrators. These challenges reflect problems in E-learning and future priorities reflect priorities in E-learning. We through the report related to the topic of conclusion and interpretation, and the architecture of the E-learning new outbreak era, aimed at further to explore the multiple scenes interactive fusion of E-learning, wisdom can assign teachers, digital tools polymerization and improve

teaching performance, k-12 curriculum MOOC of digital, E-learning strategy of the whole regional propulsion, etc. in the school, These will undoubtedly become the future E-learning and development of new propositions.

First, online education implementors need to Build a rich E-learning resource platform and a good E-learning environment. E-learning resources and environment have a direct impact on students' online learning behavior and learning results. The implementer of online education should comprehensively and deeply understand and master E-learning resources, and constantly update the understanding, classification and application of E-learning resources from the perspective of students.

Second, teachers need to actively change their roles and improve their digital literacy. E-earning as a new way of learning, teachers' teaching methods have also changed. In the process of online teaching, teachers should actively change the traditional teaching methods, from the indoctrinator of knowledge to the guide of students' learning activities; Have a comprehensive understanding of students' E-learning process, master students' emotional attitudes and needs during learning, design teaching plans and learning resources scientifically and reasonably, and guide students to conduct independent learning with students as the center; To build a learning environment that can effectively communicate and interact, to promote the exchange and discussion between students, teachers and students, and to carry out interactive teaching; Attention should be paid to the application of E-technology in the teaching process. When problems are encountered, digital tools should be actively used to deal with and solve them, such as visualizing teaching knowledge through mind mapping and semantic annotation tools, so as to influence students' learning habits in a subtle way.

Finally, Students need to enhance their information literacy and increase the frequency of participation in online learning. In the current time of information explosion, most learners will be unable to carry out efficient E-learning because of a lot of useless information, resulting in poor online learning effect. In order to be in a E-learning environment for effective learning, learners should have good information literacy, based on the scientific and reasonable learning goals and plans, can clear the required information and access to, can carry on the value judgment of access to information, digging into the valuable information quickly and efficiently, then complete the comprehension of knowledge and problem solving; Learners should clearly realize E-learning ability to participate effectively in the necessity of online learning, and combined with the needs of online learning to participate in, will clearly understand that itself is what exists in E-learning ability is insufficient, such as consciousness, technology application, behavior, management and evaluation, etc., then take targeted measures and methods to improve; By choosing some online courses related to E-learning ability, students can acquire practical knowledge in this area, and actively master and use some common E-learning tools and strategies; Increase the frequency of participating in online learning, such as participating in more online learning courses, so as to enrich online learning experience. In this

process, continue to accumulate and reflect, and gradually improve E-learning ability.

VI.   DISCUSSION

This study aims to explore the relationship between learners' E-learning ability, online learning engagement and online learning performance. The research mainly focuses on the impact of E-learning ability on online learning engagement, the impact of E-learning ability on online learning performance, the impact of online learning engagement on online learning performance, and the mediating role of online learning engagement between E-learning ability and online learning performance. Based on the learning theory, study on the related literature, on the basis of combing and reviews in detail the following E-learning ability, the engagement in online learning and online learning performance research framework and logical thinking, to college students as the research object, analyses its E-learning ability, online learning and online learning effect between performance, Finally, suggestions are put forward to improve the E-learning ability of college students from the perspectives of online education implementors, teachers and learners.

VII.   CONCLUSION (OR LIMITATION OR SUGGESTION FOR FURTHER STUDIES)

This study examines the relationship among college students' digital learning ability, online learning engagement and online learning performance, and examines the mediating role of online learning engagement. Although the research design and implementation try to be thorough, due to the limitation of conditions and lack of personal understanding, the research still has the following limitations.

(1) Sample representativeness is not carefully considered. In order to ensure the number of samples, this study uses the questionnaire "So Jump" platform and the snowball sampling method to distribute questionnaires. Due to the concentration of students in Guangzhou, the sample ignores the differences between regions and universities, and does not consider the influence of culture. Therefore, the research data cannot represent the national average level, which is one of the problems to be solved in the follow-up research.

(2) Choice of research methods did not fully consider the complexity of the research problem. This study mainly refers to the research paradigm of quantitative research, and regards the digital learning ability of college students as an objective and statistical variable, and obtains an objective understanding of the digital learning ability of college students by analysing the results of the questionnaire survey. In the research process, literature research and questionnaire survey are the main methods used. Only through literature review, the measurement scale of college students' digital learning ability is obtained, without really entering into the situation of college students' digital learning to perceive their digital learning behaviour. Although more factors were taken into account in the study design, there were a number of other possible factors that were not taken into account and

could have had some impact on the results. Therefore, in the follow-up research, it is necessary to enter the field of college students' digital learning, enrich and improve the scale of college students' digital learning ability, and take into account possible factors such as personal family background, regional economic development and modern education level.

REFERENCES

Chan S.L., Lin C.C., Chau P.H.(2021) Evaluating online learning engagement of nursing students[J] *Nurse Education Today,*104

Melissa Bond Facilitating student engagement through the flipped learning approach in K-12: A systematic review[J] *Computers & Education*, 2020, 151

Reguera Elsa Aniela Mendez, Lopez Mildred Using a digital whiteboard for student engagement in distance education[J]*Computers and Electrical Engineering,* 2021, 93

Herodotou Christothea, Maguire Claire, McDowell Nicola et al. The engagement of university teachers with predictive learning analytics[J]*Computers & Education,* 2021, 173

Si Zhang, Qingtang Liu Investigating the relationships among teachers' motivational beliefs, motivational regulation, and their learning engagement in online professional learning communities[J] *Computers & Education,* 2019, 134

Iwona Czaplinski, Andrew L. Fielding Developing a contextualised blended learning framework to enhance medical physics student learning and engagement[J] *Physica Medica,* 2020, 72(C)

Mitchell Hughes, Yenna Salamonson, Lauren Metcalfe Student engagement using multiple-attempt 'Weekly Participation Task' quizzes with undergraduate nursing students[J] *Nurse Education in Practice,* 2020, 46

de Brito Lima Felipe, Lautert Sintria Labres, Gomes Alex Sandro Contrasting levels of student engagement in blended and non-blended learning scenarios[J] *Computers & Education,* 2021, 172[1]

Silvola Anni, Näykki Piia, Kaveri Anceli et al. Expectations for supporting student engagement with learning

analytics: An academic path perspective[J] *Computers & Education,* 2021, 168

Seo Kyoungwon, Dodson Samuel, Harandi Negar M. et al. Active learning with online video: The impact of learning context on engagement[J] *Computers & Education,* 2021

Chan S.L., Lin C.C., Chau P.H. et al. Evaluating online learning engagement of nursing students[J] *Nurse Education Today,* 2021, 104

Melissa Bond Facilitating student engagement through the flipped learning approach in K-12: A systematic review[J] *Computers & Education,* 2020, 151

Reguera Elsa Aniela Mendez, Lopez Mildred Using a digital whiteboard for student engagement in distance education[J] *Computers and Electrical Engineering,* 2021, 93

Herodotou Christothea, Maguire Claire, McDowell Nicola et al. The engagement of university teachers with predictive learning analytics[J] *Computers & Education,* 2021, 173

Si Zhang, Qingtang Liu Investigating the relationships among teachers' motivational beliefs, motivational regulation, and their learning engagement in online professional learning communities[J] *Computers & Education,* 2019, 134

Iwona Czaplinski, Andrew L. Fielding Developing a contextualised blended learning framework to enhance medical physics student learning and engagement[J] *Physica Medica,* 2020, 72(C)

Mitchell Hughes, Yenna Salamonson, Lauren Metcalfe Student engagement using multiple-attempt 'Weekly Participation Task' quizzes with undergraduate nursing students[J] *Nurse Education in Practice,* 2020, 46

de Brito Lima Felipe, Lautert Sintria Labres, Gomes Alex Sandro Contrasting levels of student engagement in blended and non-blended learning scenarios[J] *Computers & Education,* 2021, 172

Zhao Jian, Li Jiaming, Jia Jian A study on posture-based teacher-student behavioral engagement pattern[J] *Sustainable Cities and Society,* 2021, 67

Shih-Yin Lin, John M. Aiken, Daniel T. Seaton et al. Exploring physics students' engagement with online instructional videos in an introductory mechanics course[J] *Physical Review Physics Education Research,* 2017, 13(2)

Aldo Ramirez-Arellano Students learning pathways in higher blended education: An analysis of complex networks perspective[J] *Computers & Education,* 2019, 141(C)

Alejandro Ortega-Arranz, Miguel L. Bote-Lorenzo, Juan I. Asensio-Pérez et al. To reward and beyond: Analyzing the effect of reward-based strategies in a MOOC[J] *Computers & Education,* 2019, 142(C)

Nina Bergdahl, Jalal Nouri, Uno Fors et al. Engagement, disengagement and performance when learning with technologies in upper secondary school[J] *Computers & Education,* 2020, 149(C)

Raby Cassandra L., Madden Joah R. Moving academic conferences online: Understanding patterns of delegate engagement[J] *Ecology and Evolution,* 2021, 11(8)

Qiujie Li, Rachel Baker The different relationships between engagement and outcomes across participant subgroups in Massive Open Online Courses[J] *Computers & Education,* 2018, 127

Yongqiang Sun, Yanping Guo, Yiming Zhao Understanding the determinants of learner engagement in MOOCs: An adaptive structuration perspective[J] *Computers & Education,* 2020, 157

Er Erkan, Gómez Sánchez Eduardo, Bote Lorenzo Miguel L. et al. Generating actionable predictions regarding MOOC learners' engagement in peer reviews[J] *Behaviour & Information Technology,* 2020, 39(12)

Golrang Hoda, Safari Ehram Applying Gamification Design to a Donation-Based Crowdfunding Platform for Improving User Engagement[J] *Entertainment Computing,* 2021

Ruth Cobos, Juan Carlos Ruiz-Garcia Improving learner engagement in MOOCs using a learning intervention system: A research study in engineering education[J] *Computer Applications in Engineering Education,* 2020, 29(4)

Mark Michael Diacopoulos, Helen Crompton A systematic review of mobile learning in social studies[J] *Computers & Education,* 2020, 154(C)

Bahaa G. Gameel, Karin Gwinn Wilkins When it comes to MOOCs, where you are from makes a difference[J] *Computers & Education,* 2019, 136

Waddington Andrew, Porter Shannon Developing social presence in online learning among nurses: exploration of the Community of Inquiry Models domain of social using a qualitative descriptive design[J] *Nurse Education in Practice,* 2021, 52

Sara H. Wilford Responsible Research and Innovation: Using the Requirements Tool for Stakeholder Engagement in Developing a Universal Design for Learning Guidelines for Practice[J] *Sustainability,* 2019, 11(10)

Luo Yiqing, Geng Cong, Pei Xianbo et al. The Evaluation of the Distance Learning Combining Webinars and Virtual Simulations for Senior Nursing Students during the COVID-19 Period[J] *Clinical Simulation in Nursing,* 2021, 57

Lu Ding, ChanMin Kim, Michael Orey Studies of student engagement in gamified online discussions[J] *Computers & Education,* 2017, 115

Feng Hsu Wang An exploration of online behaviour engagement and achievement in flipped classroom supported by learning management system[J] *Computers & Education,* 2017, 114

Lu Ding, Erkan Er, Michael Orey An exploratory study of student engagement in gamified online discussions[J] *Computers & Education,* 2018, 120

Kyle M. Williams, Rose E. Stafford, Stephanie B. Corliss et al. Examining student characteristics, goals, and engagement in Massive Open Online Courses[J] *Computers & Education,* 2018, 126

Juneyoung Park, De Liu, Mun Y. Yi et al. GAMESIT: A gamified system for information technology training[J] *Computers & Education,* 2019, 142(C)

PérezSanagustín Mar, SapunarOpazo Diego, PérezÁlvarez Ronald et al. A MOOC-based flipped experience:

Scaffolding SRL strategies improves learners' time management and engagement[J] *Computer Applications in Engineering Education,* 2020, 29(4)

Jiacheng Liao, Yan Liang, Jiahui Pan Deep facial spatiotemporal network for engagement prediction in online learning[J] *Applied Intelligence,* 2021, 51(10)

Curtis R. Henrie, Lisa R. Halverson, Charles R. Graham Measuring student engagement in technology-mediated learning: A review[J] *Computers & Education,* 2015, 90

Hyeopwoo Lee, Jinki Jung, Heung-Kyu Lee et al. Discipline vs guidance: comparison of visual engagement approaches in immersive virtual environments[J] *Multimedia Tools and Applications,* 2021

Luis R. Murillo-Zamorano, José Ángel López Sánchez, Ana Luisa Godoy-Caballero How the flipped classroom affects knowledge, skills, and engagement in higher education: Effects on students' satisfaction[J] *Computers & Education,* 2019, 141

Hans van der Meij, Paul Dunkel Effects of a review video and practice in video-based statistics training[J] *Computers & Education,* 2020, 143(C)

Hernandez Dania, Jacomino Gema, Swamy Uma et al. Measuring supports from learning assistants that promote engagement in active learning: evaluating a novel social support instrument[J] *International Journal of STEM Education,* 2021, 8(1)

Zhen Shao, Kuanchin Chen Understanding individuals' engagement and continuance intention of MOOCs: the effect of interactivity and the role of gender[J] *Internet Research,* 2021, 31(4)