The Path of New Information Technology affecting Educational Equality in the New Digital Divide— Based on Information System Success Model

Qian Zheng
Hefei University of Technology, CHINA
Anhui Science and Technology University, CHINA

Chang-Yong Liang
Hefei University of Technology, CHINA

ABSTRACT

New information technology (new IT) plays an increasingly important role in the field of education, which greatly enriches the teaching means and promotes the sharing of education resources. However, because of the New Digital Divide existing, the impact of new IT on educational equality has yet to be discussed. Based on Information System Success Model (ISSM), this research introduces the user's ability access, including skills ability access and usage ability access, to explain the relationship between the new IT application and educational equality, and has carried on the empirical test using PLS-SEM statistical analysis techniques. The results show that the system quality, information quality and service quality of new IT would directly affect the user's ability access, further affect user's intention to use and user's satisfaction, and then influence the realization of educational equality.

Keywords: educational equality(EE), new information technology(NIT), new digital divide(NDD), information system success model(ISSM)

INTRODUCTION

Along with the development of new information technology (new IT) based on cloud computing, the Internet of things and big data, new IT plays an increasingly important role in the education sector. It greatly enriches the teaching means, and promotes education resources sharing (Collins & Halverson, 2010; Ding, Xiong, & Liu, 2015). Many scholars have studied that whether new IT could promote educational equity. Some of them considered that new IT could effectively promote educational equity, which could promote a broader range of education resource sharing, and make all kinds of audiences to get the education resources without being restricted by space and time(Chen, Hwang, & Wang, 2012; Rubagiza, Were, & Sutherland, 2011). However, some scholars argued that there was the Digital Divide (DD) in

Correspondence: Chang-Yong Liang, *School of Management at Hefei University of Technology, Hefei, Anhui 230009, PR China. Tel.: +86 551 62919150.*
✉ cyl_hfut@163.com

State of the literature

- The development of new information technology promotes education resources sharing. Prior scholars argued that whether new IT could promote education equity. Some researchers proposed the digital divide, which means different opportunities of using new IT between information haves and information have-nots.
- With the cost reduction of IT device, the new digital divide, which indicates the different abilities of new IT access between information haves and have-nots, could influence education equity. It implies more attentions should be paid on IT users.
- In the new digital divide, the path of new IT affecting the educational equality should be systematically discussed.

Contribution of this paper to the literature

- Based on Information System Success Model, this research analyses the mediating effects of usage ability access and skills ability access between new IT quality and user's perception, and discuss the impact paths of them on educational equality.
- According to the study, in the new digital divide, IT user's own ability is positively related to user's intention to use and satisfaction, and then positively affect the realization of educational equality.
- Improving the quality of new IT and strengthening the training of IT user's ability could improve user's intention to use and satisfaction of new IT, and further promote educational equity.

the environment of new IT, and brought new inequality to education. DD means the differences existing in the opportunity of using new IT between information haves (IH) and information have-nots (IHN) (Cooper, 2006; Larose, Gregg, Strover, Straubhaar, & Carpenter, 2007). IHN is far less opportunity than IH to receive an online education and training based on the new IT. Hence, education inequality does not reduce, and even presents new features in the new IT environment. The traditional DD focuses on the difference of physical access, such as computers and networks (Fuchs, 2008; Vicente & López, 2011). With the cost reduction of new IT device and the spread of intelligent mobile device, some scholars proposed the New Digital Divide (NDD), which more indicated the differences existing in the abilities of new IT access, including usage access and skills access between IH and IHN (Dijk, 2012; Jackson et al., 2008).

New IT plays an important role in promoting education resources sharing by leveraging the cloud resources platform and ubiquitous internet access. However, as a new technology, the application of new IT in the field of education brings some different results and influences to the society. When discussing the impact of new IT on educational equality, it is important to analyse the path of new IT affecting the educational equality. Information System Success Model (ISSM) connects the path between the new IT application and the final benefit acquisition. ISSM considers that the information quality, system quality and service quality of new IT could ultimately influence the organization or society through the user's intention to use and satisfaction (Petter, Delone, & Mclean, 2008). Some scholars have used

ISSM to explain the impact of new IT applications on the effects of education course (Gay, 2016).

Based on ISSM, this research analyses the mediating effects of usage ability access and skills ability access in the NDD between new IT quality and user's perception, as well as discuss the impact paths of them on the educational equality. The rest of the paper is arranged as follows: the second part is the theoretical background and research hypotheses; the third part is research methodology; the fourth part is the conclusion and recommendation.

## THEORETICAL BACKGROUND AND RESEARCH HYPOTHESES

Theoretical background

Information System Success Model(ISSM) proposed by Delone and Mclean, and after continuous improvement, has eventually formed six dimensions—information quality, system quality, service quality, intention to use, user satisfaction and net welfare (Petter et al., 2008). The net welfare of the new IT application depends largely on the following logic: The information quality, system quality and service quality of new IT would directly influence the user's intention to use and satisfaction; and the user's intention to use and satisfaction would ultimately influence the net welfare of new IT to the organization or society. ISSM has been widely applied to the researches on new IT practice in many areas, and also constantly enriched and perfected (Chiu, Chao, Kao, Pu, & Huang, 2016; Mi & Lee, 2016).

Some scholars have introduced some factors of users' themselves, such as trusts and expectations, into ISSM (Mi & Lee, 2016; Whyte, Bytheway, & Edwards, 1997). The implicit premise of these researches is that users are static, passive recipients of the new IT. In fact, the use of new IT is a long-term process, which is influenced by some factors, such as dynamic environment and learning. Therefore, through guiding users, it can affect users' usages and satisfactions, and ultimately affect the net welfare. In the field of education, with the in-depth involvement of new IT, based on ISSM, some scholars have analyzed the impact factors of students' using new IT, and discussed the effect of new IT usage (Lin & Wang, 2012; Yeh & Tao, 2012). In the teaching activity, students' usages and satisfactions of new IT are influenced by external circumstances, such as teachers and technical services. Especially for IHN, the interventions of the hardware environment and education environment would directly influence the using effect of new IT, and then influence the educational equality. Hence, the application of ISSM in the field of education has yet to be discussed.

Research hypotheses

Based on ISSM, this research introduces the mediating variable—user's ability access, and analyses the impact path of new IT quality influencing educational equality. The research conceptual induction is presented in **Figure 1.**
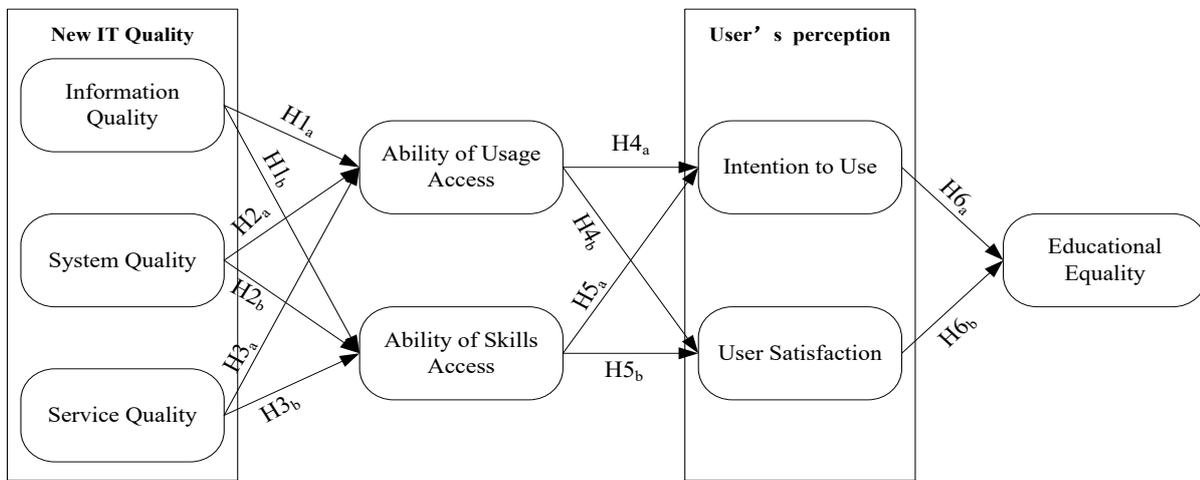
Figure 1. Research conceptual induction

The quality of new information technology

In the ISSM, Delone and Mclean divided the qualities of new IT into three dimension — information quality, system quality and service quality. Information quality focuses on the importance and richness of contents stored in the new IT; system quality refers to the reliability and stability of the software and hardware associated with information processing, delivery and receiving; service quality is the relevant operational and technical services of the new IT (Petter et al., 2008). In the field of education, Crawford et al. found that the NDD has shifted from hardware access to user's ability access. IH possess the ability to manipulate various kinds of new IT devices, and the skills ability access to identify more valuable informations (Tondeur, Sinnaeve, Houtte, & Braak, 2011; Van Deursen & Van Dijk, 2014). Compared with IHN, IH could enjoy higher information content quality, more reliable IT system, and better service quality. Hence, hypotheses could be deduced as follows:

- H1$_a$: Information quality of new IT has a positive influence on user's usage ability access.
- H1$_b$: Information quality of new IT has a positive influence on user's skills ability access.
- H2$_a$: System quality of new IT has a positive influence on user's usage ability access.
- H2$_b$: System quality of new IT has a positive influence on user's skills ability access.
- H3$_a$: Service quality of new IT has a positive influence on user's usage ability access.
- H3$_b$: Service quality of new IT has a positive influence on user's skills ability access.

User's ability access

The user's ability access has a significant impact on the intention to use of new IT and the satisfaction of using new IT (Hussein, Harun, & Oon, 2016). Some scholars have found that there is no significant time difference surfing in the internet between IH and IHN, but there is

significant content difference surfing in the internet between them. With higher learning ability access, IH have paid more attentions to "serious application", maximized the capital and resource value of new IT, and devoted to improving learning efficiency for getting better returns. On the contrary, with lower earning ability access, IHN focuses on "entertainment application", and less gets capital and resource advantages brought by new IT (Dijk, 2012; Van Deursen & Van Dijk, 2014). Hence, in the field of education, for the groups with different learning ability access, there are differences in the feedback brought by new IT. And then these differences in the feedback could influence the intention to use and satisfaction of new IT. Therefore, we proposed hypotheses:

- $H4_a$: User's usage ability access has a positive influence on user's intention to use of new IT.
- $H4_b$: User's usage ability access has a positive influence on user satisfaction of new IT.
- $H5_a$: User's skills ability access has a positive influence on user's intention to use of new IT.
- $H5_b$: User's skills ability access has a positive influence on user satisfaction of new IT.

User's intention to use and user's satisfaction

Depending on ISSM, the user's intention to use and satisfaction will influence the net welfare of organization or society. Educational equity has important social and economic significance, which is concerned by many countries. There are many prior researches discussing the relationship between the new IT and educational equity, and some researchers thought that new IT could promote educational equity (Chen et al., 2012; Hussein et al., 2016; Rubagiza et al., 2011). However, some researchers believed that New Digital Divide existed (Brandtzæg, Heim, & Karahasanović, 2011; Cooper, 2006; Dijk, 2012; Larose et al., 2007). Educational equity basically refers to the equal opportunity of education (Schleicher & Zoido, 2016), which includes three aspects: equal starting point, equal process and equal outcome (Roberts, 2010). The application of new IT will ensure that each user gets the equal educational resources. However, it depends on the user's willingness to use new IT, and the subjective experience in use. High satisfaction reinforces the user's willingness and frequency to use new IT, and thereby giving the user a truly equal access to the various educational resources in the cloud platform. Otherwise, low satisfaction will reduce the user's willingness and frequency to use new IT. And then new IT cannot play a positive role in the educational equality. Therefore, we get the following hypotheses:

- $H6_a$: User's intention to use of new IT has a positive influence on educational equality.
- $H6_b$: User satisfaction of new IT has a positive influence on educational equality.

RESEARCH METHODOLOGY

Research design

Research methods and variables

The structural equation model (SEM) is a kind of statistical modeling technique commonly used in the field of social science, which is suitable for analyzing the causal path relationships between different latent variables. The commonly used methods to estimate SEM include Covariance-based SEM (CB-SEM) and Partial Least Squares SEM (PLS-SEM). Both of them belong to the second generation of statistical techniques. In the case of large sample conditions (more than 500), little difference exists in their path analysis results. However, compared to CB-SEM, PLS-SEM can overcome some problems, such as nonnormality of data distributions, and is more suitable to the exploratory factor analysis. Meanwhile, the analysis result of PLS-SEM is still robust in a small sample condition (Hair, Ringle, & Sarstedt, 2011). Hence, this study adopts PLS-SEM to validate the hypotheses.

The main latent variables include information quality (InfQ), system quality (SysQ), service quality(SerQ), ability of usage access(AUA), ability of skills access(ASA), intention to use(ITU), user satisfaction(US), educational equality(EE).

Questionnaire design and data collection

China has a large population, and the distributions of educational resources are extremely uneven. In order to promote the educational equity, Chinese government has invested a lot of resources to set up resource sharing courses and learning platforms, such as Massive Open Online Courses (moocs). Hence, this study is mainly based on investigations of the users of China's new IT platform. We conducted a pilot test with a small sample to ensure the effectiveness of the questionnaire. After 60 questionnaires randomly surveying and preliminary analysis, we modified and formed the final questionnaire. The questionnaire mainly uses a five-point Likert-type scale, which represents 1="strongly disagree", 2="disagree", 3= "general", 4="agree" and 5=" strongly agree".

Our empirical test adopts a typical survey method, and randomly chooses people with online platform learning experience as respondents. A total of 2,365 questionnaires were distributed, and 1,172 were collected. After excluding invalid questionnaires, such as questionnaires with a leak rate above 10% or with logical contradictions, 572 valid questionnaires were collected with a response rate of 49.56% and the effective rate of 48.81%. The sample statistics are shown in **Table 1.**

Empirical testing results

This study uses the Smartpls2.0 software for data analysis. The data analysis and the results of hypotheses tests are as follows:

Table 1. Sample statistics

Categories	Number	Percent (%)
Gender		
Male	276	48.25
Female	296	51.75
Educational Background		
Primary education	27	4.72
Junior Education	159	27.80
Higher education	386	67.48
Age		
1-18	117	20.45
18-60	397	69.41
60+	58	10.14
Tatal	572	100.00

Measurement model

The measurement model analysis mainly involves the assessment of reliability and validity. **Table 2** presents the testing results of reliability and validity of the questionnaire. Cronbach'α value and Composite Reliability (CR) value are used to assess the reliability of the questionnaire. According to the criterion given by Hair et al., it indicates good internal consistency of the measurements, when Cronbach'α value and CR value are between 0.7 and 0.9(Hair et al., 2011; Jr, Ringle, & Sarstedt, 2013). All the values of Cronbach'α and CR in our research show good reliability of the questionnaires, and good correlations between the measurement items that belong to the same latent variable.

The validity of the questionnaire can be assessed by convergent validity and discriminant validity. Convergent validity is used to measure the explanatory power of the latent variable to its measurement items, which can be measured by Average Variance Extracted (AVE) value or outer-loading value of each measurement items. Discriminant validity is used to assess the distinction degrees between different latent variables, which can be measured by Fornell-Larcker criterion (Hair et al., 2011; Jr et al., 2013). According to **Table 2**, all the AVE values of latent variables are greater than 0.5 beyond the threshold value, which indicate good convergent validity of the questionnaire. Furthermore, the testing results of discriminant validity show that all the square roots of AVE value are greater than the correlation coefficients between latent variables, and the discriminant validity between latent variables is strong.

Structural model

This study adopts PLS algorithm to estimate the path coefficient, and uses the bootstrapping algorithm to test the path coefficients of the model and significance levels by

Table 2. The results of reliability and validity test

Const-ruct	Reliability		Convergent validity	Discriminant validity							
	CR	Cronbach'α	AVE	InfQ	SysQ	SerQ	AUA	ASA	ITU	US	EE
InfQ	0.843	0.801	0.608	0.780							
SysQ	0.812	0.768	0.597	0.639	0.773						
SerQ	0.874	0.840	0.630	0.658	0.543	0.794					
AUA	0.894	0.833	0.627	0.616	0.619	0.514	0.792				
ASA	0.849	0.796	0.609	0.597	0.547	0.527	0.612	0.780			
ITU	0.865	0.807	0.628	0.601	0.604	0.672	0.671	0.579	0.792		
US	0.886	0.825	0.674	0.623	0.621	0.508	0.586	0.619	0.609	0.821	
EE	0.846	0.811	0.702	0.608	0.634	0.541	0.648	0.622	0.571	0.634	0.838

Note: the square roots of AVE are shown in the diagonal line
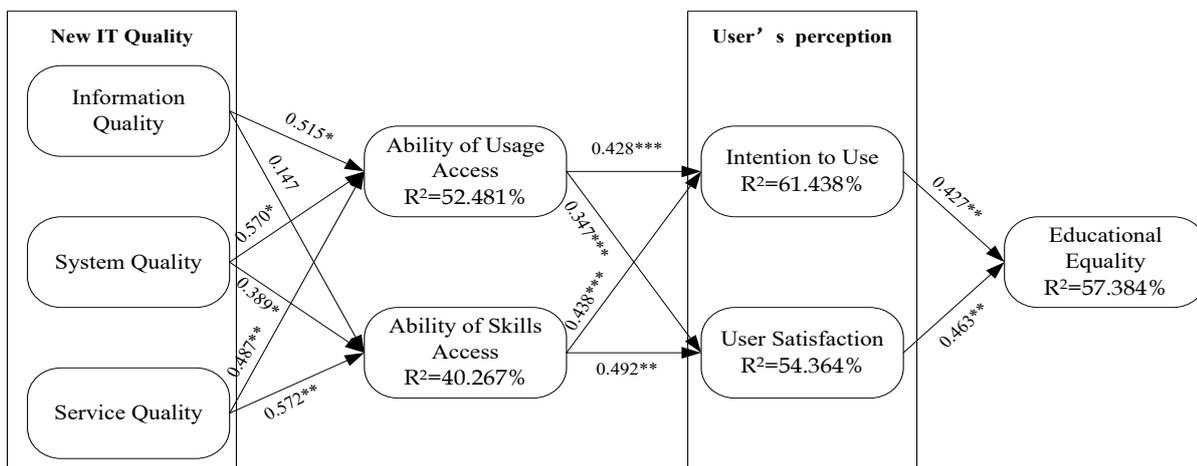
Note: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

Figure 2. The empirical results of research conceptual

non-parametric tests. The testing results, including path coefficients between latent variables and the R^2 values are given in **Figure 2.**

CONCLUSION AND RECOMMENDATION

Conclusion

Based on ISSM, this article studies the influence of the application and quality of new IT to educational equality. All the hypotheses have been supported by empirical tests except $H1_b$. Theoretically, ISSM establishes the path between the new IT quality and net welfare. However, differences of users' abilities should be considered in ISSM besides the users' intentions to use and satisfactions. The differences of users' abilities could form the differences

of various users' subjective perceptions although they face the same new IT system, and then influence the implementation of the organizational or social net welfare.

The system quality and service quality of new IT have significant impacts on the user's usage ability access and skills ability access. The information quality has a significant impact on the user's usage ability access, but a nonsignificant impact on the user's skills ability access. This may be because that the information quality belongs to the content level, concerned with the usefulness of information stored in the cloud platform, and the user's usage ability access focus on the personal skills. It is not directly related to the usefulness of information.

Moreover, the user's ability access will significantly influence user's intention to use and satisfaction of new IT platforms. The user with strong computer operational skills and information identification ability, will prefer to use the educational resource in cloud platforms and get more useful information, which form the positive feedback of ability—use—satisfaction, and vice versa.

New IT integrates many educational resources, and promotes educational equality through its open platform, which can make each user to get equal educational opportunity. However, in the NDD, the realization of educational equality is intimately related to the user's own ability. Users with high intentions to use and user satisfactions, would more obtain knowledge from the platform, and then new IT could promote to realize the educational equality. Otherwise, new IT would have nonsignificant impact on educational equality, even widen the divide between IH and IHN, if a large number of users with low using frequencies and satisfaction exist.

Recommendation

In the NDD, the promotion of new IT to the educational equity should work on the following aspects. First, improving the quality of new IT could attract more users to utilize the resource sharing platform, and provide the equity of educational opportunity. Second, we should strengthen the training of user's ability, especially the IHN, including online operational skills ability, as well as screening and filtering abilities of network information, which promote user to get more valuable information, and provide the equity of educational outcome. Third, improving the user's intention to use and satisfaction of new IT can increase the using frequency and effect of educational resources platform, and provide the equity of educational process.

ACKNOWLEDGEMENTS

REFERENCES

Brandtzæg, P. B., Heim, J., & Karahasanović, A. (2011). Understanding the new digital divide - A typology of Internet users in Europe. *International Journal of Human-Computer Studies, 69*(3), 123-138. doi:10.1016/j.ijhcs.2010.11.004

Chen, Y. C., Hwang, R. H., & Wang, C. Y. (2012). Development and evaluation of a Web 2.0 annotation system as a learning tool in an e-learning environment. *Computers & Education, 58*(4), 1094-1105. doi:10.1016/j.compedu.2011.12.017

Chiu, P. S., Chao, I., Kao, C. C., Pu, Y. H., & Huang, Y. M. (2016). Implementation and evaluation of mobile e-books in a cloud bookcase using the information system success model. *Library Hi Tech, 34*(2), 207-223. doi:10.1108/lht-12-2015-0113

Collins, A., & Halverson, R. (2010). The second educational revolution: rethinking education in the age of technology. *Journal of Computer Assisted Learning, 26*(1), 18–27. doi:10.1111/j.1365-2729.2009.00339.x

Cooper, J. (2006). The digital divide: the special case of gender. *Journal of Computer Assisted Learning, 22*(5), 320-334. doi:10.1111/j.1365-2729.2006.00185.x

Dijk, J. A. G. M. V. (2012). The evolution of the digital divide: The digital divide turns to inequality of skills and usage. *Digital Enlightenment Yearbook, 767*, 57-78. doi:10.3233/978-1-61499-057-4-57

Ding, J., Xiong, C., & Liu, H. (2015). Construction of a digital learning environment based on cloud computing. *British Journal of Educational Technology, 46*(6), 1367–1377. doi:10.1111/bjet.12208

Fuchs, C. (2008). The Role of Income Inequality in a Multivariate Cross-National Analysis of the Digital Divide. *Social Science Computer Review, 27*(1), 41-58. doi:10.1177/0894439308321628

Gay, G. H. E. (2016). An assessment of online instructor e-learning readiness before, during, and after course delivery. *Journal of Computing in Higher Education, 28*(2), 199-220. doi:10.1007/s12528-016-9115-z

Hair, J. F., Ringle, C. M., & Sarstedt, M. (2011). PLS-SEM: Indeed a Silver Bullet. *Journal of Marketing Theory & Practice, 19*(2), 139-151. doi:10.2753/mtp1069-6679190202

Hussein, Z., Harun, A., & Oon, S. W. (2016). The Influence of the Smartphone User's Characteristics on the Intention of Use of M-health. *International E-journal of Advances in Social Sciences, 2*(5), 598-602. doi:10.18769/ijasos.66580

Jackson, L. A., Zhao, Y., Kolenic III, A., Fitzgerald, H. E., Harold, R., & Von Eye, A. (2008). Race, gender, and information technology use: the new digital divide. *CyberPsychology & Behavior, 11*(4), 437-442. doi:10.1089/cpb.2007.0157

Jr, J. F. H., Ringle, C. M., & Sarstedt, M. (2013). Partial Least Squares Structural Equation Modeling: Rigorous Applications, Better Results and Higher Acceptance ☆. *Long Range Planning, 46*(1–2), 1-12. doi:10.1016/j.lrp.2013.01.001

Larose, R., Gregg, J. L., Strover, S., Straubhaar, J., & Carpenter, S. (2007). Closing the rural broadband gap: Promoting adoption of the Internet in rural America. *Telecommunications Policy, 31*(6-7), 359-373. doi:10.1016/j.telpol.2007.04.004

Lin, W. S., & Wang, C. H. (2012). Antecedences to continued intentions of adopting e-learning system in blended learning instruction: A contingency framework based on models of information system success and task-technology fit. *Computers & Education, 58*(1), 88-99. doi:10.1016/j.compedu.2011.07.008

Mi, J. N., & Lee, K. T. (2016). An analysis of the relationship between quality and user acceptance in smartphone apps. *Information Systems and e-Business Management, 14*(2), 1-19. doi:10.1007/s10257-015-0283-6

Petter, S., Delone, W., & Mclean, E. (2008). Measuring information systems success: models, dimensions, measures, and interrelationships. *European Journal of Information Systems, 17*(3), 236-263. doi:10.1057/ejis.2008.15

Roberts, K. B. (2010). Outcome and Process in Pediatric Education: Does the Whole Equal the Sum of the Parts? *Academic Pediatrics, 10*(1), 1-6. doi:10.1016/j.acap.2009.07.004

Rubagiza, J., Were, E., & Sutherland, R. (2011). Introducing ICT into schools in Rwanda: Educational challenges and opportunities. *International Journal of Educational Development, 31*(1), 37-43. doi:10.1016/j.ijedudev.2010.06.004

Schleicher, A., & Zoido, P. (2016). Global equality of educational opportunity: Creating the conditions for all students to succeed. *Journal of Social Issues, 72*(4), 696-719. doi:10.1111/josi.12190

Tondeur, J., Sinnaeve, I., Houtte, M. V., & Braak, J. V. (2011). ICT as cultural capital: The relationship between socioeconomic status and the computer-use profile of young people. *New Media & Society, 13*(1), 151-168. doi:10.1177/1461444810369245

Van Deursen, A. J. A. M., & Van Dijk, J. A. G. M. (2014). The digital divide shifts to differences in usage. *New Media & Society, 16*(3), 507-526. doi:10.1177/1461444813487959

Vicente, M. R., & López, A. J. (2011). Assessing the regional digital divide across the European Union-27. *Telecommunications Policy, 35*(483), 220-237. doi:10.1016/j.telpol.2010.12.013

Whyte, G., Bytheway, A., & Edwards, C. (1997). Understanding user perceptions of information systems success. *Journal of Strategic Information Systems, 6*(1), 35-68. doi:10.1016/s0963-8687(96)01054-2

Yeh, C. R., & Tao, Y. H. (2012). College Students' Intention to Continue Using a Personal Response System: Deriving a Model from Four Theoretical Perspectives. *Australasian Journal of Educational Technology, 28*(5), 912-930. doi:10.14742/ajet.824

http://iserjournals.com/journals/eurasia