

School and Teacher Level Predictors for Students' Information Literacy in Chinese Rural and Urban Education

Liqin Yu, Di Wu, Sha Zhu

Abstract—This study aimed to investigate the level of secondary school students' information literacy in China and examine the contribution of school and teacher level factors on students' information literacy between rural and urban schools. A total of 598 schools, 56415 students and 18286 teachers participated in this study. The findings of this study were as follows: (1) the overall of secondary schools students' information literacy only reached an average level and urban school students' information literacy were significantly higher than that of rural school students; (2) In rural schools, teachers' ICT collaboration was a positive predictor for students' information literacy, while teachers' ICT use for learning was identified as a negative predictor of students' information literacy; (3) In urban schools, ICT management, ICT operation and teachers' ICT self-efficacy were found to be significantly associated with students' information literacy. Based on the findings, suggestions for improving students' information literacy between rural and urban schools were discussed.

Keywords—Information literacy, Chinese secondary school students, rural school, urban school.

I. INTRODUCTION

INFORMATION literacy are gaining recognition as being vital for students living, learning and working in the 21st century [1], [2]. and school has been widely acknowledged as an important place for equipping their students with new kinds of skills such as information literacy [3]. Previous studies have revealed that school and teacher level factors such as ICT infrastructure, ICT classes, teachers' ICT attitude, ICT self-efficacy, ICT use in class and ICT collaboration were major predictors for students' information literacy [4], [5].

In recent years, the Chinese government announced a series of education policies to support for the cultivation of students' information literacy. For instance, in 2017, a new information technology curriculum standard was published for high schools with the aim of assisting students to use computers with greater fluency [6]. In order to accurately measure students' information literacy level, the Chinese Ministry of Education regards the assessment of students' information literacy as an important task for the development of education information in the 2.0 age [7]. Despite these efforts, there are still several problems that exist in Chinese information literacy education.

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A study showed that the overall level of Chinese secondary students was just a "pass" [8]. Some researcher also pointed out that the development of students' information literacy was unbalanced in China [9]. What is the level of students' information literacy in urban and rural schools in China? Is a significant different influence of school and teacher level factors on students' information literacy between rural and urban schools? To the best of our knowledge, little research has addressed these issues, especially in developing countries such as China. Therefore, this study aims to investigate the students' information literacy concerning rural and urban schools from a national-wide perspective. What is more, this study also aims to analyze the schools and teacher level predictors for students' information literacy in a comparison of rural and urban schools. The results of this study are expected to help policy makers and authorities to understand the status of students' information literacy in China and identify effective strategies and policies with the aim of reducing the digital divide of students' information literacy between rural schools and urban schools.

II. LITERATURE REVIEW

A. The Definition of Information Literacy

Since the term of information literacy was coined in 1974 by Paul Zurkowski, the concept of information literacy has been influenced by the evolution of the information society. Various institutions and researchers have put forward different definitions of information literacy. For example, UNESCO defined information literacy as the ability to identify, locate, evaluate, organize and effectively create, use and communicate information [10]. Another resembling definition was provided by the Educational Testing Service (ETS), which treated information literacy as the ability to use digital technology and networks to access, manage, integrate, evaluate, and create information [11]. In addition, the Association of College and Research Libraries (ACRL) defines information literacy as a set of comprehensive abilities encompassing the reflective discovery of information, the understanding of how information is produced and the recreating of new knowledge [12]. Furthermore, the Chartered Institute of Library Information Professionals (CILIP) put forward a new definition of information literacy, which emphasized the ability to think critically and express informed views [13].

More recently, with the rapid development of artificial intelligence, big data and cloud computing, computational thinking (CT) is becoming an important element for future

talents and many institutions have taken CT as a new dimension of students' information literacy [14], [15]. By consolidating the existing definition of information literacy and based on our previous studies [16], [17], four dimensions of information literacy in this study have been proposed as follows: Information Awareness and Attitude, Information Knowledge and Skills, Information Thinking and Behavior, and Information Social Responsibility. Awareness and Attitude refers to one's information sensitivity including perception awareness, application awareness, and security awareness. Knowledge and Skills include fundamental knowledge of network, internet, PC and a set of skills involved the ability to the use of ICT. Thinking and Behavior involves the ability to think critically and use the appropriate information technology to solve complex problems, create and express ideas compellingly. Social Responsibility refers to moral principles and understanding of the rules governing information activities.

B. School Level Factors Influencing Students' Information Literacy

Regarding school level variables, prior studies have reported that ICT infrastructure, school size, computer curriculum and ICT management were major predictors for students' information literacy. For example, some studies revealed that ICT availability at schools and the proportion of the ICT equipment per student own were significantly associated with students' information literacy [18], [19]. Kim et al. found that students who had a higher completion rate of computer related course showed relatively high level of information literacy [20]. Similarly, other studies showed the number of ICT classes positively correlated with the grade of students' information literacy [21]. As for the impact of school location on students' information literacy, the results were inconsistent. For instance, Kim et al. reported that students living in urban areas have a higher ICT literacy level than do students living in rural areas [22]. Whereas in other studies, students who live in provincial areas had a superior information literacy compared with students living in major cities [23], [24].

C. Teacher Level Factors Influencing Students' Information Literacy

Regarding teacher-related variables, precedent studies reported that teachers' ICT capabilities, ICT attitude, ICT self-efficacy, and ICT usage were major influential factors of students' information literacy. For example, Meelissen and Drent claimed that teachers' attitude towards ICT had an indirect effect on students' information literacy through influencing students' ICT attitude [25]. Aesaert, Vand erlinde and Tondeur reported that the ICT usage in class were associated with students' information literacy [26]. Teachers' ICT self-efficacy refers to their belief in completing ICT-related tasks. Previous studies found that teachers' ICT self-efficacy was a positive determinant of students' information literacy [27]. With respect to the teachers' ICT collaboration, Lai, Guo and Tsai claimed that collaborative teaching approach had a positive impact on students' information literacy [28].

D. The Present Study

In order to balance the development of students' information literacy in China, it is necessary to understand the status of students' information literacy and analyze the key predictors of students' information literacy concerning rural and urban schools. Although there is an extensive body of studies has documented several influential factors of students' information literacy, little research has analyzed predictors of students' information literacy by differentiating the type of schools. In addition, no large-scale assessment has been conducted so far to investigate the students' information literacy in developing countries such as China. Therefore, the following research questions are addressed in this study:

- RQ1: What's level of students' information literacy between rural and urban schools?
- RQ2: What are the major predictors of students' information literacy at school level? Is there difference between urban and rural schools?
- RQ3: What are the major predictors of students' information literacy at teacher level? Is there difference between urban and rural schools?

III. METHODOLOGY

A. Sampling

This study was conducted from October 2018 to December 2018. Three-stages of sampling method were used to collect data. In the first stage, 368 municipal and county areas were selected from 31 provinces in China according to their economic level, and urban and rural areas were in half of each province respectively. In the second stage, 3 to 5 junior high schools were selected in each of the selected districts and counties. In the third stage, students from seventh and eighth grades were randomly selected from each school. In total, this survey included 598 schools, 64.05% of them were urban schools and 35.95% of them were rural schools. A total of 56415 students and 18286 teachers also participated in this survey.

B. Instrumentation

The instruments of this study included three parts:

- 1) Students' information literacy test: A total of 41 multiple choice questions on the web platform were designed to measure students' information literacy. The four dimensions of information literacy are as follows: awareness and cognition (10 items), knowledge and skills (15 items), thinking and behavior (10 items) and social responsibility (6 items). The items for the four dimensions reached a good reliability with the value of 0.84.
- 2) A school questionnaire: The school questionnaire consisted of 21 web-based items to collect data about school ICT infrastructure, ICT resource, ICT operations, teacher ICT training and ICT management.
- 3) A teacher questionnaire: Teachers' data were collected via five scales including ICT self-efficacy (14 items), ICT use for teaching (10 items), ICT use for students' learning (13 items), ICT collaboration (5 items) and ICT attitude (8

items).

C. Data Collection and Analysis

With the help of provincial education administrative departments and local education administrative departments, students were arranged in the computer lab of each sample school to complete the information literacy test. At the same time, teachers and chief of educational information of each selected school were required to finish the teacher questionnaires and school questionnaires respectively. Students and teachers were matched through the schools' name. All participants were informed of the research purposes.

SPSS 22.0 software was used in this study. Descriptive statistics were used to describe the overall level of students' information literacy and regression analyses were conducted to explore the effect of school and teacher level factors on students' information literacy in rural and urban schools respectively.

IV. RESULTS

A. Students' Information Literacy between Urban and Rural Schools

To answer Q1, descriptive statistics and t-tests were conducted to examine the difference in students' information literacy between the urban and rural schools, as shown in Table I. On average, the information literacy of students from urban schools is 60.99, and the information literacy of students from rural schools is 54.94. The information literacy and other

dimensions including information awareness and cognition, information knowledge and skills, information thinking and behavior, information social responsibility of students from urban schools were significantly better than that of students from rural schools.

TABLE I
STUDENTS' INFORMATION LITERACY BETWEEN URBAN AND RURAL SCHOOLS

	urban		rural		F
	M	SD	M	SD	
Information literacy	60.99	15.55	54.94	15.52	10.46***
Awareness and cognition	28.82	7.40	26.55	7.56	6.42**
Knowledge and skills	9.88	3.12	8.74	3.25	9.05***
Thinking and behavior	9.58	2.53	8.48	2.25	15.05***
Social responsibility	12.71	4.40	11.18	4.59	8.32***

Note: **p < 0.01, ***p < 0.001

B. School-Level Factors Predicting Students' Information Literacy

To answer the second question, stepwise regression analysis was conducted to explore the relationship between school level factors and students' information literacy, as shown in Table II. School ICT related factors were viewed as predictors to explain the variations in students' information literacy. In urban areas, ICT operations ($t = 2.21$, $p < 0.05$) and ICT management ($t = 2.40$, $p < 0.05$) could make significant predictions (6% explained) for the students' information literacy. While in rural areas, school level factors were found less significantly associated with students' information literacy.

TABLE II
THE REGRESSION ANALYSIS OF SCHOOL-LEVEL FACTORS

Predictors	rural					urban				
	B	SE	β	t	R ²	B	SE	β	t	R ²
ICT infrastructure	1.98	7.58	0.02	0.26		4.83	5.74	0.05	0.84	
ICT resource	8.95	8.13	0.10	1.10		-1.30	5.49	-0.01	-0.24	
ICT operations	5.19	6.80	0.07	0.76	0.02	12.32	5.57	0.15	2.21*	0.06
Teacher ICT training	-4.91	6.70	-0.06	-0.73		-5.35	5.05	-0.07	-1.06	
ICT Management	0.13	8.06	0.00	0.02		13.03	5.44	0.15	2.40*	

Note: *p < .05

TABLE III
THE REGRESSION ANALYSIS OF TEACHER-LEVEL FACTORS

Predictors	Rural					Urban				
	B	SE	β	t	R ²	B	SE	β	t	R ²
ICT self-efficacy	21.09	20.92	0.11	1.01		33.84	14.27	0.17	2.37*	
ICT attitude	-22.00	20.84	-0.12	-1.06		-11.47	16.16	-0.06	-0.71	
ICT collaboration	54.43	19.73	0.29	2.78**	0.09	25.52	16.21	0.14	1.58	0.04
ICT use for teaching	42.28	23.13	0.31	1.83		9.01	19.32	0.08	0.47	
ICT use for learning	-62.56	25.24	-0.43	-2.48*		-18.43	21.34	-0.15	-0.86	

Note: *p < .05; **p < .01

C. Teacher-Level Predictors on Students' Information Literacy

To answer RQ3, stepwise regression was employed to investigate the relationship between teacher level factors and students' information literacy, as shown in Table III. In rural schools, ICT collaboration could make positive significant prediction for students' information literacy. However,

teachers' ICT use for learning made negative influence on students' information literacy. In urban schools, only teachers' ICT self-efficacy did significant impact on students' information literacy.

V. DISCUSSION AND CONCLUSION

The results of this study demonstrated that the overall of

Chinese secondary school students' information literacy only reached an average level. However, it must be noted that significant diversity of students' information literacy still exists in rural and urban schools. The Chinese government should pay more special efforts to reduce the digital divide in terms of students' information literacy [29]. More importantly, this study analyzed different influential factors predicting for students' information literacy from school and teacher level in rural and urban schools. The results could provide more insight for understanding differentiated needs regarding information literacy education between rural and urban schools.

In rural schools, the results indicated that teachers' ICT collaboration significantly associated with students' information literacy, the result was consistent with the previous studies [30]. Teachers were found to feel less work stress, gain a better understanding of curriculum and be more willing to adopt new technology in the classroom though mutual collaboration among colleagues [31]-[33]. A collaboration atmosphere of school culture and regular ICT training activities can contribute to ICT-related collaboration among teachers [34], [35]. However, it should be noted that rural teachers' ICT use for learning was found to be a negative predictor of students' information literacy. This result could be explained as due to the lack of ICT integration knowledge and ICT related competence, rural school teachers often improperly selected ICT tools in the teaching activities without the aim of developing students' information literacy [36], [37].

In urban schools, the results indicated that school level factors such as ICT management and ICT operation were positive predictors of students' information literacy. The findings are in line with earlier studies, which claimed that ICT supporting conditions is a major challenge facilitating ICT application in schools and school leadership can be identified as relevant for students' acquisition of information literacy [38], [39]. As for teacher level factors, only teachers' ICT self-efficacy was found to be positively associated with students' information literacy. This result implied that urban school teachers were more confident to use ICT in daily instruction which had a positive impact on students' information literacy [40], [41].

To conclude, junior high school students' level of information literacy has much room for improvement in China and there is a significant difference in influencing factors of students' information literacy between urban and rural schools in terms of school and teacher level factors. Differentiated strategies are needed to be considered for improving students' information literacy between rural and urban schools.

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REFERENCES

- [1] European Commission. (2007). Key competencies for lifelong learning: European reference framework. Luxembourg. Retrieved from <http://bookshop.europa.eu/en/key-competences-forlifelong-learningpbNC7807312/>.
- [2] J. Kim, & W. Lee, "Meanings of criteria and norms: analyses and comparisons of ICT literacy competencies of middle school students," *Computers & Education, J.*, vol. 64, no. 2, pp.81-94, 2013.
- [3] J. Gerick, "School level characteristics and students' CIL in Europe-A latent class analysis approach", *Computers & Education, J.*, vol.120, pp.160-171, 2018.
- [4] H. S. Kim, H. J. Kil, & A. Shin, "An analysis of variables affecting the ICT literacy level of Korean elementary school students," *Computers & Education, J.*, vol.77, pp. 29-38, 2014.
- [5] Z. J. Zhong, "From access to usage: The divide of self-reported digital skills among adolescents," *Computers & Education, J.*, vol. 56, no.3, pp.736-746, 2011.
- [6] The ministry of education (2017), Information technology curriculum standards for high schools Retrieved from <http://www.szszyw.com/dede/uploads/soft/180116/%C6%D5%CD%A8%B8%DF%D6%D0%D0%C5%CF%A2%BC%BC%CA%F5%BF%CE%B3%CC%B1%EA%D7%B2017%B0%E6.pdf>.
- [7] The Ministry of Education (2018), Education information 2.0 action plan Retrieved from http://www.moe.gov.cn/srcsite/A16/s3342/201804/t20180425_334188.html.
- [8] Y. Li, & M. Ranieri, "Are 'digital natives' really digitally competent? A study on Chinese teenagers", *British Journal of Educational Technology, J.*, vol.41 no. 6, pp.1029-1042, 2010.
- [9] H. Zhang, & C. Zhu, "A study of digital media literacy of the 5th and 6th grade primary students in Beijing," *The Asia-Pacific Education Researcher, J.*, vol. 25, no. 4, pp. 579-592, 2016.
- [10] UNESCO. (2007). THE PRAGUE DECLARATION "TOWARDS AN INFORMATION LITERATE SOCIETY". Retrieved from <http://www.unesco.org/new/fileadmin/MULTIMEDIA/HQ/CI/CI/pdf/PragueDeclaration.pdf>.
- [11] Educational Testing Service. (2007). Digital transformation: A framework for ICT literacy. A report of the international ICT literacy panel. Princeton: Center for Global Assessment. Retrieved from https://www.ets.org/Media/Tests/Information_and_Communication_Technology_Literacy/ictreport.pdf.
- [12] ACRL. (2016). Framework for Information Literacy for Higher Education. Retrieved from <http://www.ala.org/acrl/sites/ala.org/acrl/files/content/issues/infolit/framework1.pdf>.
- [13] CILIP. (2018). CILIP Definition of Information Literacy 2018. Retrieved from <https://infolit.org.uk/ILdefinitionCILIP2018.pdf>.
- [14] H. S. Kim, S. H. Ahn, & C. M. Kim, "A New ICT Literacy Test for Elementary and Middle School Students in Republic of Korea," *The Asia-Pacific Education Researcher, J.*, vol. 28, no.3, 203-212, 2019.
- [15] IEA. (2016). The IEA's International computer and information literacy study (ICILS) 2018: What's next for IEA's ICILS 2018. Retrieved from <http://www.iea.nl/sites/default/files/studies/IEA%20ICILS%202018%20Computational%20Thinking%20Leaflet.pdf>.
- [16] S. Zhu, D. Wu, Y. H. Shi, & L. Q. Yu, "International comparative study on students' information literacy assessment and enlightenments". *China Educational Technology, J.*, vol. 368, no.9, pp. 25-32, 2017 (in Chinese).
- [17] S. Zhu, H. H. Yang, J. MacLeod, L. Yu, & D. Wu, "Investigating Teenage Students' Information Literacy in China: A Social Cognitive Theory Perspective". *The Asia-Pacific Education Researcher, J.*, vol. 28, no.3, pp.251-263, 2019.
- [18] Z. J. Zhong, "From access to usage: The divide of self-reported digital skills among adolescents," *Computers & Education, J.*, vol. 56, no.3, pp.736-746, 2011.
- [19] S. S. Seo, K. S. Min, K. H. Hwang, Y. J. Chang, & H. S. Kim, "Developing and validating ICT literacy test for elementary school students". *Journal of Educational Technology, J.*, vol. 25, no.5, pp.193-220, 2009.
- [20] H. S. Kim, H. J. Kil, & A. Shin, "An analysis of variables affecting the ICT literacy level of Korean elementary school students," *Computers & Education, J.*, vol.77, pp.29-38, 2014.
- [21] K.S. Kim, S.Y. Lee, W.C. Jun, H.S. Kim, J.H. Kim, H.S. Kwak, et al, "Measuring ICT literacy of primary and junior high school students in South Korea," *The Journal of Korea Elementary Education, J.*, vol. 22, no. 3, pp. 195-211, 2011.
- [22] H. S. Kim, H. J. Kil, & A. Shin, "An analysis of variables affecting the ICT literacy level of Korean elementary school students," *Computers & Education, J.*, vol.77, pp.29-38, 2014.
- [23] S. S. Seo, K. S. Min, K. H. Hwang, Y. J. Chang, & H. S. Kim,

- "Developing and validating ICT literacy test for elementary school students," *Journal of Educational Technology. J.*, vol. 25, no. 5, pp.193–220, 2009.
- [24] S. G. Baek, D. I. Kim, M. R. Kim, H. S. Kim, Y. L. Yu, S. H. Park et al, "The development of standardized ICT literacy assessment for secondary school student," *Asian Journal of Education. J.*, vol.10, no.1, pp.175–198, 2009.
- [25] M. R. Meelissen, & M. Drent, "Gender differences in computer attitudes: Does the school matter?," *Computers in Human behavior. J.*, vol. 24, no. 3, pp. 969-985, 2008.
- [26] K. Aesaert, D. Van Nijlen, R. Vanderlinde, J. Tondeur, I. Devlieger, & J.van Braak, "The contribution of pupil, classroom and school level characteristics to primary school pupils' ICT competences: A performance-based approach," *Computers & Education. J.*, vol.87, pp. 55-69, 2015.
- [27] M. R.Meelissen, & M.Drent, "Gender differences in computer attitudes: Does the school matter?," *Computers in Human behavior. J.*, vol. 24, no. 3, pp. 969-985, 2008.
- [28] Y. L. Lai, S. J. Guo, & C. H. Tsai, "Using collaborative teaching and inquiry-based learning to help elementary school students develop information literacy and information technology skills". in *Conf. In European Conference on Information Literacy*, Springer, Cham, 2014, pp.436-445.
- [29] K. Chetty, L. Qigui, N. Gcora, J. Josie, L. Wenwei, & C. Fang, "Bridging the digital divide: measuring digital literacy," *Economics: The Open-Access, Open-Assessment E-Journal. J.*, vol.12 no. 23, pp.1-20, 2018.
- [30] S. Zhu, H. H. Yang, J. MacLeod, L. Yu, & D. Wu, "Investigating Teenage Students' Information Literacy in China: A Social Cognitive Theory Perspective," *The Asia-Pacific Education Researcher. J.*, vol.28 no. 3, pp. 251-263, 2019.
- [31] Eickelmann B (2010) Factors contributing to a sustainable implementation of digital media in schools and classrooms – empirical analyses and some consequences for teacher education. In: *proceedings of 21st international conference of SITE, Society for Information Technology & Teacher Education, San Diego, USA*, pp.1421–1428.
- [32] Fraillon, J., Ainley, J., Schulz, W., Friedman, T., & Gebhardt, E. (2014). Preparing for life in a digital age: The IEA International Computer and Information Literacy Study international report. Springer Open.
- [33] A. C.Cheung, & R. E. Slavin, "The effectiveness of educational technology applications for enhancing mathematics achievement in K-12 classrooms: A meta-analysis," *Educational research review. J.*, vol. 9, pp. 88-113, 2013.
- [34] K.Drossel, B.Eickelmann, & R.Schulz-Zander, "Determinants of teachers' collaborative use of information and communications technology for teaching and learning: A European perspective," *European Educational Research Journal. J.*, vol.16, no.6, pp.781-799, 2017.
- [35] J.Tondeur, M.Valcke, & J.Van Braak, "A multidimensional approach to determinants of computer use in primary education: Teacher and school characteristics," *Journal of Computer Assisted Learning. J.*, vol. 24, no. 6, pp.494-506, 2008.
- [36] X.,He, & D. Wray, *Digital literacies in a Chinese secondary school Handbook*. Springer, Cham, 2017.
- [37] A.Howley, L.Wood, & B.Hough, "Rural elementary school teachers' technology integration," *J. Journal of Research in Rural Education. J.*, vol. 29, no.9, pp.1-18, 2014.
- [38] D.Wu, C. C.Li, W. T.Zhou, C. C.Tsai, & C.Lu, "Relationship between ICT supporting conditions and ICT application in Chinese urban and rural basic education, " *Asia Pacific Education Review. J.*, vol.20, no 1, pp.147-157, 2019.
- [39] R.Lorenz, B.Eickelmann, & J.Gerick, " What affects students' computer and information literacy around the world?–An analysis of school and teacher factors in high performing countries, " in *Society for Information Technology & Teacher Education International Conference*, 2015, pp.1212-1219.
- [40] K. Aesaert, D.Van Nijlen, R.Vanderlinde, J.Tondeur, I. Devlieger, & J. van Braak, "The contribution of pupil, classroom and school level characteristics to primary school pupils' ICT competences: A performance-based approach", *Computers & Education. J.*, vol. 87, pp. 55-69, 2015.
- [41] M. Papastergiou, "Enhancing physical education and sport science students' self-efficacy and attitudes regarding information and communication technologies through a computer literacy course," *Computer & Education J.*, vol. 54, pp. 298–308, 2010.

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