Shih, JL. et al. (Eds.) (2023). Proceedings of the 31st International Conference on Computers in Education. Asia-Pacific Society for Computers in Education

Promoting Teachers' Digital Literacy Achievement: A Nationwide Survey of Education Informatization in China

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Abstract: Education informatization is one of the paramount issues in educational reform. To resonate with Chinese national progress in technology development and national policy for promoting education reform and modernization, this study ascertains the current status of education informatization and teachers' use of technology in teaching and learning in China. Data from a national survey on primary and secondary schools and teachers about the performance of education informatization was analyzed. According to the results, teachers' use of technology in teaching is a reinforcement of traditional pedagogy; innovative functions such as the communication and evaluation of teaching and learning are under-utilized. On the basis of this finding, promoting education informatization needs to promote teachers' coherent Digital Literacy (DL) integration competence. Meanwhile, a professional gap in using digital educational resources was found among teachers. The Ministry of Education, Science & Technology (MEST) and the research team have put sustained efforts to guide the development of education informatization in China, and the results of this study serve as evidence for policymakers and principles to promote teacher professional development in line with the changes of new requirements for teachers' teaching ability in this information era.

Keywords: Teacher Professional Development, education informatization

1. Introduction

Education has evolved alongside global informatization. In 2019, drawing on a range of educational reforms China has undergone since 1978, the Chinese State Council devised and instituted China's Education Modernization 2035 Plan (2035 Plan) and the Implementation Plan for Accelerating Education Modernization (2018-2022). These two documents aimed at substantially modernizing China's education system by 2035. Over the past three decades, the central government strengthened national network coverage, connecting all primary and secondary schools by 2020, with half of them having wireless networks (Dong et al., 2021; Zeng, 2022). Recent focus gradually shifted from device construction to innovating Digital Educational Resources (DERs). To resonate with Chinese technology development and national policy for promoting education reform and modernization, the Ministry of Education has carried out training programmes for teachers and principals in Information and Communications Technology (ICT) in the pedagogical application during the past years (Zeng, 2022).

Even though the nationwide infrastructure has been built, education informatization will be accomplished in actually only when teachers and principals are competent enough to systematically utilize technologies to leverage career-related activities (Kim & Lee, 2011). In pursuit of advancing education informatization, a national survey was conducted by MEST in 2020, focusing on primary and secondary schools. This study presents national survey data concerning teachers' technology integration in teaching and learning (T&L) and the present state of education informatization in schools. Additionally, this study aims to identify potential areas for improvement and strategic focus to promote education informatization in China based on the current landscape.

2. Theoretical Background

The necessity of education informatization emerges as technology develops. The development trajectory of national policy for education informatization usually follows the sequence from simply using technology and modifying technology to serve the education needs to integrating technology for innovative education practices (Zeng, 2022). Education informatization has had a significant impact on improving classroom teaching. Except for upgrading infrastructure, teachers' DL is an important step to leverage education informatization (Howard & Tondeur, 2023) for maximum potential.

Empirically, DL encompasses competencies like computer literacy, ICT literacy, information literacy, and media literacy, allowing individuals to access, manage, evaluate, and create information through digital technologies (Law, Woo, de la Torre, & Wong, 2018).

Prior research emphasized the importance of effective ICT support in universities for preservice teachers (Wang & Zhao, 2021). Although society and industry introduce new technology to schools, its actual integration is usually reported as a reinforcement of traditional approaches (TAN & PARK, 2016) rather than truly transformative education. Only when the integration and utilization of technology are led by education itself, the education informatization is truly meaningful. True education informatization requires teachers' coherent DL integration competence, fostering productive activities and the creation of pedagogical knowledge (Howard et al., 2023; Kim et al., 2011).

Past research focused on theoretical aspects of China's educational informatization. This study presents up-to-date data and analysis on the current state of China's educational informatization, offering insights to government and higher education decision-makers, aiding policy formulation. This study also adds to the previous research by exploring the mediation and moderation role of teachers' professional background and DERs habits. Three research questions (RQs) underpin this research: RQ1: What is the current DL achievement of teachers? RQ2: What is the current education informatization level of schools? RQ3: What needs to be focused on to advance the DL achievement of teachers?

3. Study Method

Our study was based on the national survey data conducted in 2020 by Chinese MEST as part of a territory-wide evaluation of implementing the Education Informatization Promotion Plan. Considering the large population and enormous education scale in China, for the convenience of analysis, this study selected data from three representative provinces from the eastern (Province A), central (Province B), and western (Province C) regions of China.

3.1 Index Description and Data Analysis

The education informatization index in this study, drawing from prior research (Kim et al., 2011), encompasses three dimensions: accessibility, utilization, and usability. Accessibility refers to the accessibility level of infrastructure (hardware, software, internet connection, multi-media classroom, etc.) established for T&L in schools. Utilization is the extent to which education informatization is employed within schools. Usability is teachers' overall use of technologies, including the use of DERs and software, and the coherent DL integration competence in different T&L sectors, which refers to overall DL achievement in this study.

Diversity of ICT curriculums provided by schools, frequency of the teacher professional development on DL competency, and years of teaching are adopted to explore further possible elements that could advance the DL achievement of teachers.

Data analysis utilized SPSS and Microsoft Excel. Descriptive statistics summarized the questionnaire's primary outcome. Educational background differences were assessed with the Chi-square test. The moderation and mediation effect models were applied to uncover potential moderating and mediating factors affecting teachers' DL achievement.

4. Result

4.1 Descriptive Statistics

A sample size of 131347 in-service primary and secondary teachers completed the online questionnaire, with 103739 (79%) teachers graduating from a teacher education programme. A total of 13352 schools from 57 cities completed the online questionnaire.

4.1.1 Teachers' DL Performance (RQ1)

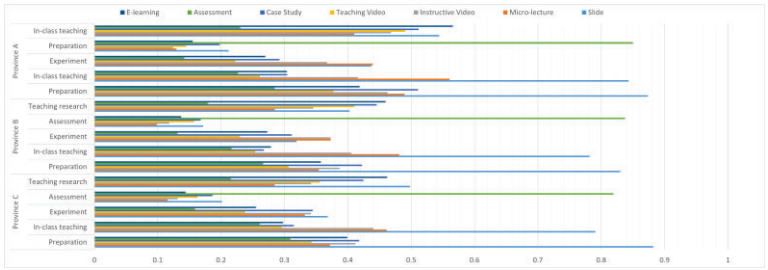

Figure 1. Types of DERs Used in Different T&L Activity

Figure 1. indicates most teachers tend to use traditional DERs like Slides in in-class teaching and preparation stage, and use DERs like assessment tool for assessments. The use of DERs in teaching research and experiment are rare.

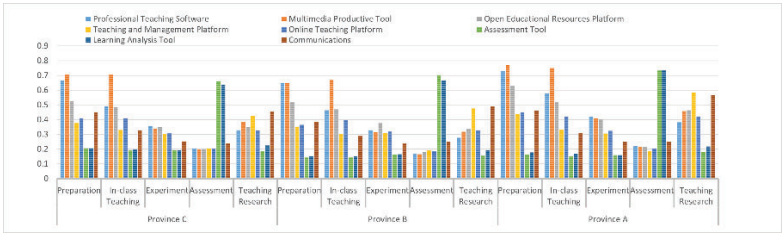

Figure 2. Types of Software Used in Different T&L Activity

Figure 2 illustrates the prevalent usage of multimedia productivity tools, professional teaching software, and assessment tools among teachers. The adoption of open educational resources platforms, teaching and management platforms, and online teaching platforms is limited.

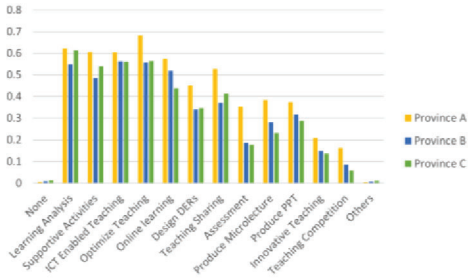

Figure 3. DL Achievement in Different T&L Activity

Figure 3. indicates an overall DL achievement of teachers that teachers actively utilize information technology in T&L activities, including learning analysis, supportive activities, teaching, teaching optimization, online learning, designing DERs, and teaching sharing sessions. The utilization of technology in other activities is relatively low.

4.1.2 Schools' Education Informatization (RQ2)

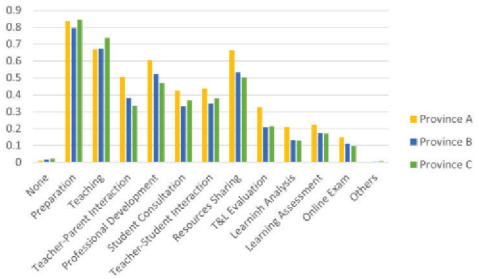

Figure 4. Schools' Utilization Level of Education Informatization

Figure 4. indicates that at the school level, the utilization of education informatization mainly appears in preparation, teaching, resource sharing, and professional development. Teacher-to-parents and teacher-to-student communication through technology are rare. And the utilization of education informatization in learning analysis and teaching evaluation is low.

4.2 Possible Influence Factors on Teachers' DL Achievement (RQ3)

The Chi-square test results (Table 1.) indicated a trend toward significance for the effect of educational background on the frequency of using DERs among in-service teachers ($p < 0.001$). Teachers who graduated from the teacher education programme (TEP) had a higher percentage of using DERs more frequently, while teachers who graduated from the non-teacher education programme (NTEP) tended to use DERs less frequently.

Table 1. *Group Differences in the Frequency of Using DERs (***p<0.001)*

	Background	Never	Rarely	Sometimes	Often	Always	Total	Chi-Square test
Preparation	TEP	2322	5974	10725	34072	50631	103724	192.738***
	NTEP	556	1298	2535	8511	14708	27068	
In-class	TEP	1527	5235	10092	30484	56401	103739	86.735***
	NTEP	345	1213	2451	7788	15811	27608	
Experiment	TEP	46018	33432	13006	4693	1908	1043	167.808***
	NTEP	11156	9176	3836	1480	578	305	
Examination	TEP	60907	27556	7975	2482	981	546	127.191***
	NTEP	15261	7688	2403	797	311	170	
Innovation	TEP	30821	30043	17691	8829	4934	3249	38.533***
	NTEP	7822	7874	4872	2386	1359	926	

4.2.1 Mediation Effects on Teachers' DL Achievements

Table 2 shows the mediating effects of DER diversity on the relationship between software diversity and DL achievements. The direct effects of software diversity on both DER diversity and DL achievements were strong and significant (Coeff. = .590, $p < .001$; Coeff. = .396, $p < .001$). Similarly, the direct effect of DER diversity on DL achievements was also significant (Coeff. = .209, $p < .001$). The mediation condition (Figure 5.) was met as the indirect effect of software diversity on DL achievements through DER diversity was significant.

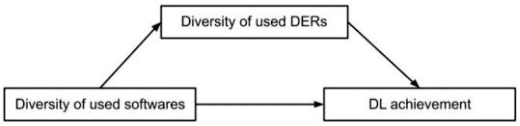

Figure 5. Hypothesis Model for Software Used, DERs Used, and DL Achievement

Table 2. *Mediation Effect on DL Achievement (via Diversity) (*** p < 0.001)*

	Diversity _ DERs	DL Achievement
Diversity _ Software	0.590***(235.914)	0.396***(119.165)
Diversity _ DERs		0.209***(57.628)

4.2.2 Moderating Effect on the Diversity of the Used DERs

Table 3 displays the interaction (Figure 6.) between DL achievement and years of teaching in predicting DER diversity. The interaction effect was significant ($p < .05$). Simple slope test results indicated a significant positive relationship between DL achievement and DER diversity when years of teaching were low (CI {-0.0031, -0.0016}, $t = -6.1289$, $p < 0.05$). Years of teaching significantly predicted DER diversity when DL achievement was the same. Less experienced teachers showed higher diversity in using DERs for teaching.

Furthermore, the above mediating and moderating analyses suggest a reciprocal relationship between teachers' DL achievement and the diversity of used DERs. It proposes that higher diversity of used DERs is indicative of enhancing teachers' DL achievement, and higher DL achievement leads to increased diversity of used DERs.

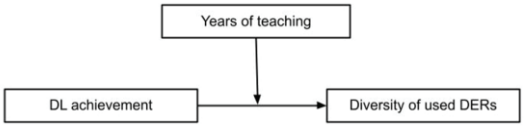

Figure 6. Hypothesis Model for DL Achievement, Years of Teaching and DERs Used

Table 3. *Moderation Effect of Years of Teaching*

	t	p	LLCI	ULCI
Constant	192.6895	0	8.9412	9.125
DL achievement	99.4889	0	0.8259	0.8591
Years of teaching	-5.2969	0	-0.0142	-0.0065
Int_1	-6.1289	0	-0.0031	-0.0016

4.2.3 Mediation Effects on Teacher Professional Development

Table 4 shows the mediated effects between schools' utilization level of education informatization and teacher professional development frequency through accessibility level. The utilization level had a strong and significant direct effect on accessibility (Coeff. = 4.311, $p < .001$) and on teacher professional development frequency (Coeff. = 6.513, $p < .001$). Similarly, accessibility level had a strong and significant direct effect on teacher professional development frequency (Coeff. = 1.269, $p < .001$). This meets the mediation condition (Figure 7.) where the indirect effect of schools' utilization level of education informatization on teacher professional development frequency through accessibility level was significant.

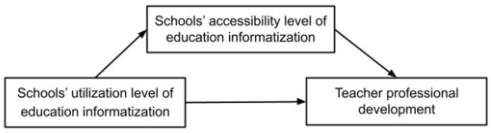

Figure 7. Hypothesis Model for Software Used, DERs Used, and DL Achievement

Table 4. *Mediation Effect on DL Achievement (via Diversity) (*** p < 0.001)*

	Accessibility level	Teacher professional development
Utilization level	4.311***(15.964)	6.513***(3.823)
Accessibility level		1.269***(23.728)

5. Discussion

For RQ1, the descriptive statistics reveal that the most frequently used DERs and software were quite traditional, aligned with previous study (TAN & PARK, 2016). More innovative resources like a micro lecture and teaching and management platform are under-utilized.

Regarding RQ2, the utilization of education informatization at the school level was mainly focused on teaching and teacher professional development. The communication and T&A evaluation functions need to be more utilized.

Regarding RQ3, younger teachers tended to use more DERs, and more diversity of DERs used led to higher DL achievement in different T&L activities, which aligned with the conclusions revealed in previous studies (Wang & Zhao, 2021). This may be due to younger teachers perceived the power of technology in their teacher preparation programs, while older teachers usually received traditional programs. Also, teachers who graduated from TEP showed a higher frequency of using DERs. At school levels, with the same utilization level of education informatization, schools with higher accessibility levels tended to provide more teacher professional development.

6. Conclusion

This paper reports on the current situation of education informatization in China and contributes to revealing important insights for administering education informatization promotion. From a theoretical aspect, observations can be made that teacher professional development is the significant factor that would cause an increase in the use of DERs, leading to higher DL achievements. From the aspect of ICT policy-making, these findings may serve as receptive suggestions for promoting teachers' DL achievement. The accessibility level of informatization provides chances for teacher professional development, but at the same time, policymakers need to realize that except for infrastructure building, on top of recognition for education informatization, resources should also be allocated for teacher capacity building. After all, the return on infrastructure investment depends on teachers who implement the curriculum.

MEST and the research team have put sustained efforts to guide the education informatization in China and better promote the 2035 Plan. The results of this study serve as evidence for policymakers to focus and reallocate resources for teacher professional development to line with the changes of new requirements for teachers' teaching ability in this information era.

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