From policy to practice: Integrating ICT in Chinese rural schools

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Abstract

Research has often ignored the complex systemic nature of ICT integration in education, including the importance of the historical, social, and political context. This study examines the content of local ICT policy plans that have been developed and how school leaders and teachers perceive their experience with ICT practices of rural schools. A mixed-method research approach was applied, involving 25 rural schools in Western China. Data was collected from multiple sources (policy documents, interviews with school leaders, focus groups with teachers, classroom observations, an ICT inventory, and a teacher survey). The results revealed three types of challenges for ICT integration in rural schools: (1) guidance and learning opportunities as a political challenge, (2) sound ICT infrastructure and appropriate digital content as a technical challenge, and (3) teacher training and technical support as a human challenge. These challenges have implications for policymakers and practitioners when improving rural education through ICT integration.

Keywords

Policy plans; ICT integration; Rural education; Pedagogical use of ICT

2.1 Introduction

Researchers and policymakers around the world increasingly acknowledge the importance of developing policy plans to facilitate the integration of information and communication technology (ICT) in education (Goktas, Gedik, & Baydas, 2013; Vanderlinde, Dexter, & Van Braak, 2012). Policymakers recognise that ICT has the power to improve classroom teaching through appropriate pedagogical approaches, especially to connect rural and remote areas to education opportunities (UNESCO, 2015). Many large-scale ICT projects for education started some years ago in developing countries (Blignaut, Hinostroza, Els, & Brun, 2010). The results of these projects often do not meet the high expectations of ICT and investments: while strategic policies at the national level provide a vision of future education enriched by ICT, the operational policies at the local level consider the local budget and constraints to realise the vision (Fishman & Zhang, 2003).

In order to support effective teaching and learning in meeting educational goals, more attention needs to be paid to local possibilities (Tan, 2016). This is particularly the case in rural schools where, in general, teaching is found to be less effective, and teachers are less qualified compared to urban areas (Liu & Onwuegbuzie, 2012). Insights into both local ICT policy plans and the experience of rural schools may therefore provide us with a better understanding of teachers' pedagogical use of ICT. In this exploratory study, we aim to contribute to insights into whether and how local ICT policy plans are linked with the ICT practices of rural schools. In particular, the present study examines the content of local ICT policy plans that have been developed and how school leaders and teachers perceive their experience with ICT practices.

2.2 ICT integration in education

2.2.1 ICT integration in the context of rural schools in China

Despite all students in China having equal access to nine years of compulsory education, the Chinese government faces challenges in ensuring educational equity and quality education for all students. In particular, the urban-rural gap and regional inequality are long-standing problems and result in considerable

special funding and projects for western and rural China. The situation in 2015, however, was that 'some educational administrations and schools still do not fully recognize the revolutionary impact of ICT on education,' and "'the two skins' phenomenon of ICT and education still exists" (Ministry of Education of the People's Republic of China [MOE], 2016). In order to promote ICT in education in a more in-depth way, the MOE issued the '13th Five-year Plan for ICT in Education (2016-2020)'. Local governments have formulated and implemented their policy plans in response to the call of the MOE. In 2018 alone, some 20 provinces and municipalities have issued official documents to improve the integration of ICT and education.

Taking into account China's national conditions, there is a strong emphasis on shifting from a 'technology focus' to a 'pedagogic focus', and from a traditional 'teacher-centred' pedagogy into a 'student-centred' pedagogy. However, the ICT policy implementation process is complex because it is influenced by different stakeholders at different levels and alignment of different level policies. More importantly, it is necessary to consider the changing contextual conditions of school climate (Tondeur, Krug, Bill, Smulders, & Zhu, 2015) and the relationships and interactions of ICT between school leaders and teachers (Vanderlinde, Van Braak, & Dexter, 2012).

2.2.2 Key elements affecting ICT integration in schools

Given the interconnectedness of personal, pedagogical, and organisational contexts, we used the Four in Balance (FIB) model as a framework to identify various factors that are affecting the success and/or failure of ICT integration in rural schools (Kennisnet, 2013). According to the FIB model (Figure 2.1), successful ICT integration requires the balanced deployment of four basic elements: vision, expertise, digital content, and ICT infrastructure. Leadership is a necessary element for ensuring the balance between the key elements through support and collaboration.

Firstly, the vision of school leaders and teachers determines the success of ICT integration and the design and organisation of teaching. In order to arrive at a shared vision, a school ICT policy plan that 'translates' the national

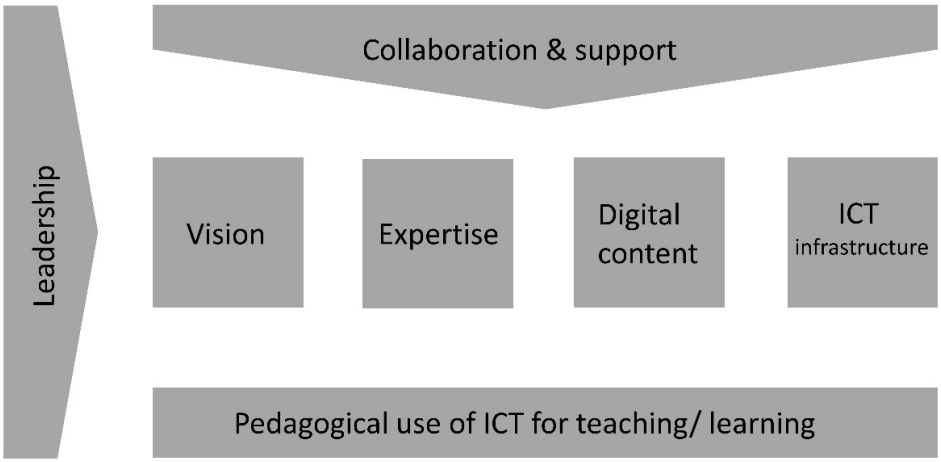

Figure 2.1. Theoretical framework (adapted from Kennisnet, 2013).

ICT policy plans into an ICT plan as part of the overall school policy can act as a possible lever for successful ICT integration (Vanderlinde, Van Braak, & Hermans, 2009). For ICT policy plans to have the best implementation effect, the readiness of teachers needs attention (Akcaoglu, Gumus, Bellibas, & Boyer, 2015). Secondly, as teachers play a crucial role in the implementation process, sufficient expertise is necessary to integrate ICT in the classroom (Wang, Tigelaar, & Admiraal, 2019). It takes time for teachers to learn new technologies and become familiar with using them, which highlights the importance of teacher training being aligned with wider policy interests (Hennessy, Harrison, & Wamakote, 2010). In addition to developing competencies using ICT, Lai and Bower (2019) show that affective elements such as attitudes, beliefs, and motivation toward using ICT are crucial when using in ICT in education. For example, teachers with more positive beliefs and attitudes are more inclined to use technology and adjust their roles, and to enact more student-centred teaching (Lumagbas, Smith, Care, & Scoular, 2019). Thirdly, a teacher's integration of ICT in classrooms is known to be enhanced by facilitating a sound infrastructure, which refers to the availability and quality of computers and internet connections within schools. The unavailability of ICT equipment for instruction and the low density of internet connectivity in classrooms

still pose challenges for rural schools (Howie, 2010). Lastly, appropriate digital content encompassing digital learning materials, educational software packages, ICT systems, and management software is vital for meeting the needs and expectations of rural teachers. A lack of quality content that can be easily adapted and used by teachers means that teachers have to spend a lot of time searching for ready-made materials that they can repurpose for their class or developing their resources to better serve their learners (Vrasidas, 2015).

Beyond the importance of the basic elements described above, the role of leadership in managing ICT integration has been identified as a key element related to the level and extent of ICT policy implementation and theorising ICT practices (Hadjithoma-Garstka, 2011). The effective use of ICT requires effort from school leaders when it comes to involving teachers and developing a shared vision (Vanderlinde, Van Braak, et al., 2012). In addition to providing professional development activities, teachers also need readily available technical support in schools to integrate ICT in their teaching (Inan & Lowther, 2010). Meanwhile, the adequate provision of financial support from both the central government and local governments is important for maintaining quality in education, and sometimes school leaders are involved in the purchase of resources (Maher, Phelps, Urane, & Lee, 2012). Another key factor connected to ICT integration is teacher collaboration to share knowledge and experiences and work on pedagogical issues (Shin, 2015). Agyei and Voogt (2012) showed that collaboration with others stimulates teachers to create technology-integrated lesson plans and materials, and develop relevant knowledge.

2.3 Method

2.3.1 Research context

Three regions were purposefully selected using the following criteria: location in Western China, and local ICT policy plans aimed at promoting ICT integration in rural areas. The sample comprised school leaders and teachers from eight or nine schools per region to provide various educational contexts and practices.

2.3.2 Participants

The background characteristics of the rural schools and the number of participants are presented in Table 2.1. A total of 39 school leaders of 25 rural schools were interviewed, 462 teachers completed the survey, and 35 teachers participated in focus group discussions after having completed the survey.

2.3.3 Procedure and instruments

Table 2.2 shows the research questions and connected data sources. One ICT policy plan for each of the three regions was analysed with regard to the first research question based on the following criteria: the plans were published by the local governments, aligned with the national plan, and implemented in 2016-2020 period.

Data from multiple sources was collected to answer the second research question. Interviews and focus group discussions were the main data sources and others provided additional or supplementary informational resources (see Table 2.2).

Data was collected during school site visits. A semi-structured interview with school leaders was first organised in each school. These were individual interviews with school principals; However, in some schools, because the principals were not familiar with the ICT work in their schools, the school principal and an ICT coordinator were interviewed together. In School A-04, no interview was held as the school leaders were unavailable. An interview protocol has been developed, reflecting factors at the school level. The interviews started with an introduction to the research, in which interviewees were informed that their audiotaped interview would be transcribed and anonymised.

The rural schools' background information and ICT inventories were provided by the interviewed school leaders (see Table 2.1 for details). The teachers completed a survey to examine their frequency of use based on a list of ten types of digital content. All of the survey items were rated on a seven-point scale ranging from 1 = never to 7 = always. School policy documents were also collected to gain a comprehensive understanding of school profiles and ICT planning. Teachers' use ICT in class, such as a teacher's use of digital

Table 2.1. Background characteristics (including ICT inventory) of the rural schools and accessible participants.

School number	School location	Grade level	Number of students	Number of teachers	Broad-band speed (Mbps)	Proportion of multimedia classrooms (%)	Student/ PC ratio	Number of computers per 100 students	Number of school leaders interviewed	Number of teacher filled in the survey (valid/ total)	Number of lessons observed	Number of teachers in group
A-01	town	7-9	1742	109	500	100	16:1	17	1	21/24	1	0
A-02	town	1-6	409	21	500	100	10:1	10	1	15/15	1	6
A-03	village	1-6	367	19	500	100	5.4:1	9	3	14/16	1	0
A-04	village	1-6	146	8	100	50	0	0	0	6/7	1	0
A-05	town	1-6	483	23	100	60	9:1	9	2	21/21	1	0
A-06	town	7-9	1200	77	100	100	10:1	10	2	31/32	1	6
A-07	village	1-3	44	4	100	50	0	0	1	4/4	1	0
A-08	village	1-6	239	10	100	100	5.4:1	19	2	10/10	1	0
B-01	town	7-9	725	87	100	100	8:1	12.8	2	22/24	1	0
B-02	town	1-6	306	31	100	100	4:1	16.7	2	15/15	1	0
B-03	town	1-6	756	45	100	100	7.9:1	12.3	1	26/26	1	0
B-04	village	1-6	184	18	100	100	25:1	19.9	1	9/9	1	0
B-05	village	1-6	1284	69	100	100	10:1	9.9	1	25/25	1	6
B-06	village	1	101	4	100	100	11:1	9	1	4/4	1	0
B-07	town	7-9	1275	107	50	100	20:1	9.8	1	20/20	1	6
B-08	town	1-6	2650	133	100	100	12.4:1	8.8	3	18/19	1	0
B-09	town	1-6	1455	87	100	100	11.6:1	9	2	13/14	1	0
C-01	town	7-9	618	55	200	100	8.8:1	11	1	20/21	1	0
C-02	town	1-6	1566	94	10	100	15:1	7	2	31/31	1	0
C-03	town	1-9	4139	262	120	100	12:1	15	1	39/40	1	6
C-04	town	1-9	2396	186	80	100	12.5	8	2	21/22	0	0
C-05	town	1-6	1341	89	100	100	18.6:1	5.2	2	20/22	1	0
C-06	town	7-9	1321	127	100	100	5.7:1	17.6	1	22/22	1	0
C-07	town	1-6	671	43	100	100	7:1	14	2	18/22	1	0
C-08	town	1-9	1832	115	100	100	9:1	10.9	2	17/17	1	

Table 2.2. Research questions and data sources.

Research questions	Categories	Data sources						
		Local ICT policy plans	Interviews with school leaders	Focus groups with teachers	School policy documents	Classroom observations	Teacher survey	ICT inventory
RQ1: ICT integration in local policy plans		×						
RQ2: ICT practices	1. Vision		×	×	×			
	2. Expertise		×	×		×		
	3. Digital content		×	×			×	
	4. ICT infrastructure		×	×				×
	5. Leadership		×	×				
	6. Support		×	×				
	7. Collaboration		×	×				
	8. Pedagogical use of ICT		×	×		×		

Note: × in the table indicates that data source was available

content with electronic whiteboards and student use of clickers, was observed and videotaped, and field notes were collected. In total, twenty-four classroom sessions were observed with attention for multimedia classroom type, digital content used, ICT infrastructure used, and the pedagogical approach.

Secondly, data was collected in each region to identify the perceptions of rural teachers of the use of ICT through two focus-group interviews (six in total), each lasting about one hour. The interviews included a total of five statements (e.g., 'I can use ICT in various teaching activities') and probing questions (e.g., 'What training have you received?') built around the key elements of ICT integration. Sessions were videotaped in order to identify and confirm who answered questions, and permissions were approved by the teachers. Our final sample consisted of 35 teachers teaching various subjects at the primary and secondary school level. Teachers ranged from having as little as one year of teaching experience with ICT to more than ten years.

2.3.4 Analysis

Directed content analysis (Hsieh & Shannon, 2005) was conducted to answer the first research question by examining elements for ICT integration presented in the local ICT policy plans. The three policy plans were carefully read and texts were coded using the FIB model as a framework for analysis. Consistent with the elements in the FIB model, relevant parts in local ICT policy plans, such as development goals, objectives, ICT projects, and safeguard measures, were coded in the eight categories (vision, expertise, digital content, ICT infrastructure, leadership, support, collaboration and pedagogical use of ICT), as detailed in Appendix A.

Within- and cross-case analyses as described in Miles and Huberman (1994) were used to answer the second research question. After the first author reading the textual materials several times, a structured coding scheme was used for the analysis containing the main coding areas. The first set of codes focused on the background information about the participants and the schools. The next set contained elements from the FIB model reflecting their ICT practices (see Appendix B for a detailed description of the codes). During the phases of

analysis, all data from each school as a case was brought together and a within-case analysis was applied. The results of the previous analysis of each school were then submitted to a cross-case analysis in which the schools were systematically compared for similarities and differences.

In order to improve reliability by measuring agreement between multiple coders, a researcher (not a team member) checked the results matrix and coded two school leader and focus group interviews independently. After discussing each code and identifying areas lacking agreement, three minor changes were made. Firstly, one subcategory of teacher professional development strategies was added in the leadership category. Secondly, a distinction was made between purposes for using ICT in the vision category and attitudes toward using ICT in expertise category. Thirdly, a distinction was made between the prescription in the leadership category and pedagogical support in the support category. The first author then repeated the previous steps to analyse all data. The other two authors reviewed the categories and subcategories, and the final agreement was reached. In the end, all eight categories in the FIB model were identified and twenty-three subcategories emerged from the data, which can be found in Appendix B.

2.3.5 Research purpose

Connecting local ICT policy plans to the pedagogical use of ICT in practice could help rural schools to improve teaching and student learning. This study therefore reports on key elements for integrating ICT in rural schools reflected in both local ICT policy plans and practices. The following research questions guided our study: (1) How are elements of ICT integration in schools represented in local ICT policy plans? (2) What are rural school practices with ICT from the perspectives of both school leaders and teachers?

2.4 Results

The results are structured in eight sections, referring to the model presented in Figure 2.1. More details are included in Appendix A (for the local ICT policy plans) and B (for the school practices). In each section, we first present results

for the content of local ICT policy plans, and then the results for the ICT practices of the rural schools.

2.4.1 Vision

Development ambitions were presented in all local ICT policy plans. However, these ambitions seemed dependent on local conditions. In terms of the development level, Region B aimed for the highest rank in the western regions, while Region C, which had a better development background, aimed for first-class at national level.

The data on ICT practices reveals that there were no formal written ICT policy plans available in ten schools, although ICT policy plans were presented in other plans (e.g., teaching and research work plan and curriculum reform plan) in nine schools. Although most of the plans were developed by school leaders, the schools involved in the 'Smart School Pilot Project' usually had the most materials (e.g., proposals for applying pilot schools and annual reporting materials) regarding the innovative use of ICT. Specialised ICT policy plans were found in only six schools and the school leader from School C-06 indicated that no updated version had been available since 2010, due to a lack of guidance.

The school leaders and teachers provided further insight into the purpose of ICT use during the interviews. Only leaders and teachers from the 'smart schools' mentioned specific goals that building smart classrooms for smart learning based on the local ICT policy plans, and that they tried to fulfil this purpose. The majority of school leaders indicated that their school's goal was to gradually improve their classroom teaching quality and efficiency, and teachers saw ICT as a means to promote student learning.

2.4.2 Expertise

Improving teaching competences in pedagogical design, content presentation, and assessment to use ICT in everyday teaching practices was regarded as an important objective in three plans. The teacher training programs in Policy C involved the most types of teachers (i.e., general teachers, rural backbone teachers and excellent class teachers) and Policy A was unique for including

teachers in teaching sites in remote areas. In addition to teachers' ICT skills improvement, improving students' ICT literacy to help students use ICT for self-directed learning was also presented in both Policy B and C.

According to school practice data, all the school leaders and teachers participated in continuous training. School leaders indicated that the teachers' basic ICT skills (e.g., using an interactive whiteboard) were sufficient, which was confirmed from classroom observations. School leaders worried about the integration of ICT and pedagogy, however, due to a lack of high-level skills (e.g., using an interactive whiteboard to activate students).

In the focus-group interviews, most teachers showed a positive attitude towards ICT, because of the benefits of using ICT in rural schools. However, a small number of teachers worried about the side effects of ICT on students, such as prolonged exposure to digital screens potentially causing eye damage and students paying more attention to animation than the teaching content. Some teachers who had been accustomed to the traditional non-digital teaching method for several decades accepted ICT slowly and hesitated to integrate ICT into their teaching.

2.4.3 Digital content

All ICT policy plans attached importance to quality digital education resources and the educational resources public service platform construction and e-governance improvement. Schools, enterprises, and governments participated in the production of digital content for primary and secondary schools to enable quality education resources construction. To promote the balanced development of urban and rural education, Policy C planned to establish three high-quality online schools sharing digital content nationwide. All three regional plans emphasised the connectivity between the national and local platforms to realise the joint construction and sharing of quality resources.

It was clear from the data on school ICT practices that teachers made considerable use of traditional digital content and used more innovative content less often. The teachers' responses from the survey with regard to how often they use particular digital content are summarised in Table 2.3.

Table 2.3. Descriptive statistics of teachers' use of varied types of digital content in teaching practices *(N = 462)*.

Scale	Mean	SD
Multimedia courseware	5.61	1.23
Multimedia material	5.18	1.23
Electronic lesson plans	5.23	1.39
Teaching videos of famous teachers	4.25	1.17
Question bank	4.48	1.37
Microvideo	3.73	1.20
Subject software and tools	3.08	1.54
Online course	3.51	1.35
Website	3.70	1.43
E-books	3.37	1.41

According to the practice data available, digital content was mainly obtained using resources in school, searching the internet, or national or local platforms. In all three regions, school leaders confirmed that the local government had purchased software and promoted the public educational resource service platform by signing agreements with publishers. Although teachers agreed that the amount of digital content available continued to increase, the amount of digital content in different subjects and types varied greatly. Teachers believed that the digital content online was not always compatible with their textbooks, and so they were more enthusiastic about the materials (e.g., the CD-ROM for the teacher's book) that were supplied along with textbooks. Except for a few schools where leaders purchased commercial resources, teachers in most rural schools needed to spend a lot of time and energy in creating or customising digital content.

2.4.4 ICT infrastructure

All subcategories of ICT infrastructure were found in the policy plan, including computers, multimedia devices, and the Internet. As the analysis indicated, there were significantly more schools with access to ICT infrastructure. As formulated in Policy C, all schools were connected with a wired and wireless network, each teacher had one computer, and multimedia equipment was

available in every classroom by 2015. Although Policy B has similar indicators, its completion goal was delayed with five years. The indicators in Policy A did not seem as clear as in the other two plans.

According to the ICT inventory data available in Table 2.1, all schools had access to basic infrastructure, but the conditions varied. The data on ICT practices revealed that almost all teachers in Region C had their own laptops, but most other teachers, especially in Region A, had to share computers with two or more colleagues. Except for the 'smart classrooms' (of which two and four were found in two of the schools visited) where students use clickers or tablets in class, student digital devices were mainly available in computer rooms. Two schools located in Region A did not own one single student computer. It was clear that the rural schools closer to the city centre were more likely to be equipped with better electronic whiteboards, and others in remote areas continued to use traditional laser projection or electronic whiteboards purchased many years ago. Both school leaders and teachers believed that outdated multimedia equipment affected the effectiveness of teaching and learning. For example, School C-06 had been damaged by a terrible earthquake in 2008 and most of the school's equipment had been in use since then.

2.4.5 Leadership

In the policy plans, the assessment of the use of ICT in schools was the key to ensuring the implementation of ICT. Setting chief information officer (CIO) positions in primary and secondary schools to guide the ICT development was also highlighted. Based on Policy C, Region C has taken the lead in setting up CIO positions in the primary and secondary schools on a large scale since 2014.

Data on actual practices showed that no one seemed to know about the request to set up CIO positions in their schools. Yet, according to teacher perceptions, the overall participation of school leaders in facilitating ICT use was high. School leaders reported that they set up a leadership team or an information centre and adopted different strategies to promote teachers' professional development. The most commonly mentioned strategies involved in making the training content specific to meet the needs of teachers in different

schools, subjects, and teaching skill levels. Some leaders also emphasised the role of supervision and models.

Teachers had the freedom to decide what ICT to use and how to use it, except for some exceptional circumstances (e.g., teaching competitions). All the teachers in Region B were requested by the local government to use multimedia equipment in the 'growth classroom' to achieve the growth of both teachers and students using a student-centred teaching approach and dealing with practical problems.

2.4.6 Support

The pilot school and regional construction had been the focus of pedagogical support in the local ICT policy plans. For example, three hundred 'smart schools' would be built by 2020 in Region B to facilitate the exchange of experiences from good practices. Technical support was rarely presented in these plans and only Policy A emphasised accelerating the construction of a professional technical maintenance team. Financial support was provided through multiple investment mechanisms involving governments, schools, enterprise, and society. Although increasing the public funds per student for ICT in education was included in these plans, only Policy B indicated increasing financial support for schools in rural and remote areas.

According to the practice data, three types of support (pedagogical, technical, and financial) were also found in rural schools. School leaders who had positive attitudes toward ICT use were more likely to attach importance to pedagogical support by encouraging teachers to change their roles in teaching and providing support for the integrated use of ICT. As mentioned above, a small number of school leaders purchased digital content, which cost from 14 to 11,000 dollars to support teaching.

The results of focus-group interviews showed that teachers had access to technical support, but normally only one or two teachers with teaching tasks were responsible for maintenance and simple repairs. Teachers believed that these 'technicians' were unable to give sufficient support and thus hoped that full-time professional staff would carry out the work in the near future. Technical

support regarding maintenance and replacement was available outside schools from companies or product suppliers, but satisfaction varied from school to school.

2.4.7 Collaboration

Collaboration in promoting the integration of ICT in education was found in policy plans. While Policy A seemed to ignore the importance of global collaboration, Policy C highlighted implementing the global partnership program and an international collaboration program for teacher capacity improvement. All three plans tried to strengthen school-business partnerships and promote purchase services.

Findings from individual and the focus-group interviews confirmed that teacher collaboration was available within- and across- schools in the form of sharing resources within the design teams, preparing for lessons together, and exchanging ideas for instructional design. Collaboration was mostly used by the teachers to prepare lessons and for different purposes. In Region A, the teaching workload was quite heavy, with 20 lessons each week, and thus they were encouraged to prepare lessons together to reduce the burden. Two secondary schools in Region C, however, collaborated with one famous network school by preparing lessons online twice a month, aiming to improve teaching quality.

A remarkable finding from school-leader interviews was that several schools in Region A collaborated by conducting 1+N synchronous teaching practice to address the digital divide. A 1+N synchronous teaching practice involves a Blended Synchronous Classroom (BSC) that integrates two or more physical classrooms to support online real-time interaction among teachers and students in different locations. During this teaching practice, one teacher in a multimedia classroom in a central school is responsible for preparing and teaching lessons, while teachers in other schools are mainly responsible for preparing lessons and managing the classes. This practice was driven by a provincial project in 2017 aimed at solving the problems of insufficient teachers, and Region A was one of the pilot areas.

2.4.8 Pedagogical use of ICT

Despite the differences above, the content for the pedagogical use of ICT in the three plans was similar, focusing on shifting to ICT use for student-centred teaching. Local governments hoped to use emerging technologies to develop the practical abilities of students in innovative ways. The change in pedagogical approaches was also seen as an important way of improving teaching quality by adopting situational and flipped teaching methods, and using the project-based learning method.

The classroom observations identified six multimedia classroom configurations. In all the lessons observed, teachers used multimedia equipment, but in only two lessons every student used a digital device in class. Besides, only one lesson was observed in the pilot school, involving the use of student clickers, the teacher's mobile phone, and specific software installed in the interactive whiteboard, and where teacher and students interactions and timely feedback were noted. Learning in this technology-rich classroom seemed to provide students with more opportunities to be engaged and meeting personalized learning needs. According to the school leader interview, specific guidance from school leaders and local government was also available.

The general view of the pedagogical use of ICT in rural schools focused on knowledge transfer and the pedagogical approach tended to be teacher-centred. Overall, the observed teachers used multimedia courseware and materials to teach in new lessons, and they used the teaching booth to present student assignments in review lessons. During these lessons, teachers decided what students learned and when, checked that students had mastered the subject matter, and asked numerous questions about it. Although many teachers in Region B used student-driven instruction, there was much more variation in the other schools.

2.5 Discussion and conclusion

This study aimed to examine ICT and education integration in rural schools and the link between local ICT policy plans and the ICT practices of rural schools. The discussion centres on the challenges and opportunities for integrating ICT in rural schools.

2.5.1 Key challenges for translating policy plans to ICT practices in schools

2.5.1.1 Political challenge in local ICT policy plans

Regarding the first research question, all elements in the FIB model were represented in the local ICT policy plans, but the vision of local ICT policy plans was not shared by all school leaders and teachers. The three plans seek to integrate ICT into the process of innovation in teaching and learning and focus on ICT integration within a learner-centred pedagogy. Data analysis regarding rural school practices revealed that practitioners in most rural schools seemed to have no ideas about whether or how to develop or update their plans, and teachers used ICT based on their personal teaching beliefs. The disconnect between policy goals and practical reality in this study showed that a national or local policy plan alone would not easily result in pedagogical changes in schools. These results were in line with the findings of another study, in which providing 'how-to' guidance at the local level and having chances to learn policy-related materials were important pre-conditions for teachers to integrate ICT into their daily practice, and for sustainable implementation (Fishman & Zhang, 2003).

2.5.1.2 Technical and human challenges for ICT practices in rural schools

With respect to the second research question in this study as a reference, two technical and human challenges for ICT practitioners in rural schools refer to the lack of a sound ICT infrastructure and appropriate digital content, and inadequate teacher training and technical support, respectively. Firstly, in contrast to the earlier findings of Howie (2010), that physical access posed challenges in rural schools, the ICT practices found in rural schools suggests that a lack of sound ICT infrastructure in terms of wireless internet, sufficient computers and updated equipment will be a new technical challenge in such settings in addressing the urban-rural gap. A second technical challenge is that the lack of contextually appropriate digital content needs to be addressed, although a large amount of digital content was available. This finding supports Vrasidas's (2015) claim that implementing an ICT-based lesson plan in the classroom required much more planning than a traditional lesson. Similarly, the current study concurs with findings that alignment between available

digital content and course content affected the degree of congruence with a teacher's previous practices, and therefore teachers were willing to let go of their traditional practices whenever able to find the 'right fit' between the digital and course content (Pareja Roblin et al., 2018).

Furthermore, the results indicate that the majority of teachers had positive attitudes toward ICT use and teachers gained basic ICT skills from continuous training programs, but teachers used ICT teacher-centered. These results could be explained by other findings that ICT merely allowed teachers to continue to fulfil their traditional roles and teacher professional development programs needed to be aligned with wider national and local policy interests (Hennessy et al., 2010). Another important human challenge was that the majority of schools revealed a poor supportive school environment for ICT integration and therefore recruitment or the appointment of professional and technical staff for rural schools was needed. The findings are in accordance with earlier research that stressed the important role of the ICT coordinators acting as curriculum managers and change agents to facilitate the integration process of ICT (Vanderlinde, et al., 2009).

2.5.2 Implications for policymakers and practitioners

Based on present evidence, there are implications for policymakers and practitioner to consider. First, to address the political challenge mentioned above, in several studies it has been suggested that integrating research knowledge (e.g., learning theory) directly with practical guidance about the pedagogical use of ICT is the most useful approach to advancing education reform in general and prompting shifts in pedagogy in particular (Fishman & Zhang, 2003). It is also important to stress that the schools that were most successful in integrating innovative ICT were those pilot schools where proposals regarding the innovative use of ICT were available. This is similar to what was found in an earlier study conducted in Chile, in which schools had to take ownership for implementing ICT by submitting proposals to the government before receiving the equipment and training (Howie, 2010). The results of the current study thus suggest that an iterative process of planning and implementation of ICT

integration in rural schools, for example, developing evidence-use ICT policy plans and conducting evidence-use practices (Rickinson, de Bruin, Walsh, & Hall, 2017), should be considered.

Also, school ICT policy plans are needed that are multifaceted and related to the school's culture to maximise the impact of ICT policy plans for school practices (Vanderlinde, Van Braak, et al., 2012). That is, there is a strong need for school leaders to involve teachers developing a school ICT policy plan. For example, in a multiple case study conducted by Vanderlinde, Van Braak, and Tondeur (2010) the process of developing a school ICT policy plan and the supportive role of school leaders within this process is being illustrated, and this example can be inspiring for other schools especially in developing countries where few school ICT policy plans are found.

Finally, to enable teachers to be successful in ICT integration in rural schools, a collaboration that is based on teachers' needs and their geographical settings at the school level and local level may be an effective approach to explore. At the school level, sharing digital content and exchanging ideas with colleagues could be beneficial for addressing technical and human challenges. For example, engaging teachers in collaborative design teams might help them to obtain contextually appropriate digital content, and acquire ICT integration skills (Agyei & Voogt, 2012). The exploration of across-school collaboration (e.g., BSC) is also promising as an innovation practice that offers the potential for promoting education quality, especially in mountainous areas. Evidence that BSC could significantly improve the academic performance and study efficiency of rural students is available in China (Yang, Yu, & Chen, 2019).

2.5.3 Limitations and suggestions for future research

Firstly, a limitation to the current study is that the number of rural schools participating in this exploratory study was small considering the huge geographical and social differences in rural China and their ICT practices were measured during one visit. In order to maximise the impact of ICT policy plans and realise educational change, future research is needed to explore whether or not the opportunities we emphasised here would be effective to improve rural

education. Secondly, the results regarding pedagogical use were mainly based on a single lesson observation in each school. Future studies could build on a longitudinal approach to explore the long-term effect of these elements on ICT integration in rural schools.