Policy Suggestions for Fostering Teacher ICT Competencies in Developing Countries: An ODA Project Case in Peru[*]

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Many developing countries consider ICT as a key enabler to improve their educational systems and teachers are viewed as change agents. This paper aims to present policy suggestions concerning how to foster teachers' ICT competencies in developing countries based on the outcomes of an ODA project case in Peru. This study was conducted through three stages: Literature survey, site visit, and policy suggestions. To draw relevant policy suggestions, we employed the framework of the 'macro-meso-micro' level of teacher professional development. The following policy suggestions are discussed: (a) macro level: to develop the national framework of teacher ICT competencies and competency-based teacher training, (b) meso-level: to promote teacher communities of practices and school-based research programs, and (c) micro-level: to redesign teacher professional development programs to help teachers better understand the complex relationships between content, pedagogy, and technology, beyond learning about basic ICT literacy skills. This study contributes to the understanding of how ODA projects can approach the issue of teacher ICT capacity building at multiple levels.

Keywords : ICT in education, Teacher ICT competency, Official Development Assistance (ODA)

Introduction

In 2015, the United Nations announced the Sustainable Development Goals (SDGs) with 17 specific goals encompassing economic, social, and environmental dimensions that the global community must achieve in cooperation by 2030. Education is the fourth goal in SDGs that aims "to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all" (United Nations, 2015, p.19, called Education 2030 hereinafter). In the Education 2030 framework for actions, Information Communication Technologies (ICTs) have been discussed as a critical factor for expanding educational opportunities, enhancing the quality of education, and leading educational change and innovation.

Developing countries, however, are facing several challenges in integrating ICT to achieve the goal of Education 2030. Challenges include the lack of technical and human resources as well as insufficient domestic funds required to build the necessary infrastructure (UNESCO, 2015). Achieving the Education 2030 agenda with the mission of 'no one left behind', hence, necessitates the mobilization of resources to help countries in need of international co-operation. Official Development Assistance (ODA) is a mechanism of mobilizing resources and funds from donor countries to support the economic and social development of recipient countries. While there is still a debate about how to define developed countries and developing countries, donor countries in the frame of ODA generally refer to developed countries that offer development aid through official agencies whereas recipient countries are developing countries, ranging from low-income to upper-income countries and territories that receive international aid.

South Korea is the only country that transformed from the recipient to the donor country and joined the Organization for Economic Cooperation and Development (OECD) as the Assistance Committee Member State in 2009. Since then, the South Korean government has been expanding the ODA policy and projects to support developing countries. In recent years, the proportion of ICT-related projects in ODA has been increasing, reflecting growing demands from

developing countries for cooperation and advice on policy initiatives to learn from the South Korean experiences in the field of ICT in education.

It is important to note that the focus of ODA projects in the education sector is shifting from providing hardware resources such as the provision of technical devices and the establishment of schools to supporting human resources such as training, knowledge sharing, technical advice, and capacity building. In particular, teachers are recognized as a critical factor that supports the sustainable development of ODA projects beyond the initial investment of financial and material resources (Kim, 2017). However, there is little understanding and research available concerning how to build teacher capacities in the context of ODA, especially fostering teacher ICT competencies in developing countries. Existing literature remains at the theoretical and conceptual discussions about competency development stages (e.g., Kozma & Vota, 2014) and the establishment of macro-level competency standards (e.g., UNESCO, 2018). This leads to the lack of concrete cases and stories that researchers can refer to when working on ODA projects with developing countries.

With this backdrop, this study presents a concrete case of the ODA project that aims to provide policy suggestions concerning how to foster teacher ICT competencies in developing countries. In particular, this study is situated in the context of the ODA consulting project called 'Technical Advice for ICT in Education' conducted in Peru after the Ministers of Education of South Korea and Peru signed a memorandum of understanding for educational cooperation in implementing the project in July 2015. Developing teacher ICT capacities was one of the key policy advice made as to the outcome of the project.

The main research question that this study aims to address is how to support the development of teacher ICT competencies using Peru as a case of the developing countries in the context of the ODA project. To this end, we employ the macro-meso-micro level of the teacher professional development model proposed by Twining et al. (2013) as an analytical lens to understand the status of teacher ICT competencies in Peru and to draw relevant policy suggestions as the outcome of

this project. Employing such an analytical lens is to acknowledge that it is essential to systematically unpack the reality where teachers are facing with careful consideration of the myriad factors surrounding them. Through the case of the ODA project in Peru, this study intends to contribute to the understanding of how ODA projects can approach the issue of teacher ICT capacity building and draw policy suggestions. Another contribution of this study is to present the history and status of ICT in education and teacher education policy in Peru, which has been rarely published in the international scene as well as the South Korean context.

Literature Review

ICT and teachers in the Education 2030 agenda

The history of establishing the global agenda for educational goals goes back to the second World Education Forum held in Dakar, Senegal in 2000. In this forum, UNESCO adopted the six *'Education for All'* (EFA) goals that the world must achieve jointly by 2015 toward the development of the universal, quality and equitable education systems for all children and youth (World Education Forum, 2000). In the third World Education Forum held in Incheon, South Korea in 2015, the *Incheon Declaration* was announced as the global education agenda for the next 15 years (2015-2030). The Education 2030 agenda aims "to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all" (United Nations, 2015, p.19) and delineates the framework for action to achieve this overarching goal.

The key difference between the EFA and the 2030 Education can be discussed in two main aspects. First, the role of ICT is clearly stated in the 2030 Education agenda. In the *Incheon Declaration*, ICT is viewed as an important strategy for establishing an equitable education system, accessing information, supporting effective learning, and providing efficient services (UNESCO, 2016a). The

importance of ICT can be also seen in the fact that UNESCO held a high-level forum in Qingdao in succession with the 2015 World Education Forum to clarify the role of ICT in achieving the 2030 Education goals. The *Qingdao Declaration* adopted in this forum delineated seven key elements to leverage the full potential of ICT to achieve the 2030 Education goal agenda (UNESCO, 2015). The seven key elements are (1) expanding access and inclusion in education, (2) using Open Educational Resources (OERs) and open standards, (3) integrating ICT competence and information literacy into the curriculum, (4) enhancing the quality of online learning, (5) encouraging innovative teaching methods utilizing ICT and innovation of teacher training institutions, (6) monitoring for evidence-based educational policy decisions, and (7) strengthening global partnerships and cooperation.

Another key difference is that the Education 2030 agenda has set 'improving the quality of teachers' as one of the specific goals. In particular, this goal highlights the need for increasing the supply of qualified teachers in developing countries through international cooperation. The EFA agenda was successful in improving quantitative measures of education such as the improvement of literacy rates and the expansion of basic education opportunities. However, EFA could not address the issue of improving the quality of teachers as seen in many developing countries that focused on supplying teachers with insufficient qualifications and competencies who did not receive proper teacher training (UNESCO, 2014). The Education 2030 agenda, hence, aims not only to increase the supply of teachers but also to improve the overall quality of teachers through proper training and qualification standards. This emphasis is made due to the vicious cycle seen in developing countries where unqualified teachers are placed in schools to resolve the shortage of teachers, which leads to another problem where unqualified teachers provide students with poor-quality education. By setting the improvement of the quality of teachers as one of the core goals, the Education 2030 agenda re-confirms that the global community must work together to pursue the quality of education beyond the basic growth of education in quantitative measures.

Teacher ICT competencies in developing countries

Teachers play an important role in the innovation process of education. Several studies have discussed the importance of developing teacher ICT competencies in the context of developing countries (Hinostroza, 2018; Owen et al., 2018). Mwapwele (2019) suggests that teachers in developing countries lack content knowledge and digital competencies related to teaching and learning with ICT. Further, teachers face many difficulties in the ICT integration due to the lack of teacher training, professional development, and necessary infrastructure.

There are increasing demands to teach students about the core competencies for the 21st century learning such as communication, critical thinking, collaboration, and creativity. Developing countries, however, tend to remain covering basic education only such as literacy and numeracy through traditional methods since the primary policy goal in education is to expand educational opportunities with the given finances and resources, often in a limited degree. To enhance competitive power in the changing global landscape, developing countries should shift the focus of education from knowledge transmission to knowledge creation targeting higher-level learning processes and outcomes. To do so, teacher professional development, and a shift to the learner-centered paradigm have emerged as important issues (UNESCO, 2016b).

From a macro perspective, Kozma (2003) emphasizes that national-level ICT policy plays an important role since the policy presents a clear vision, goal, and reason for integrating ICT in the educational system. Based on this perspective, UNESCO developed the 'UNESCO ICT Competency Framework for Teachers (CFT)'. Currently, CFT Version 3.0 has been released, reflecting the 2030 Education agenda and the recent changes in the digital learning environment (UNESCO, 2018). In this framework shown in Table 1, teacher ICT competencies are divided into three stages: knowledge acquisition, knowledge deepening, and knowledge creation. Each stage is differentiated in six aspects: (1) understanding ICT in education policy, (2), curriculum and assessment, (3) pedagogy, (4)

application of digital skills, (5) organization and administration, and (6) teacher professional learning. In the first stage '*knowledge acquisition*, it is important for teachers to develop the basic capacity to use ICT while responding to and supporting the national education policy. The second stage '*knowledge deepening*' means that teachers must develop the ability to apply ICT to help students acquire in-depth knowledge and solve complex problems. The final stage '*knowledge creation*' views teachers as the agents of change and emphasizes teacher autonomy and potential for leading and enacting innovation. In this stage, students use ICT tools for developing high-order thinking skills such as complex problem solving, communication, collaboration, critical thinking, and creative activities. Teachers need to acquire the knowledge and skills necessary to design ICT-based learning environments that support these activities. Although three stages are proposed separately in the framework, UNESCO (2018) stated that the framework can be adapted depending on the degree to which ICT is integrated into the social, economic, and educational systems in each country.

Table 1. UNESCO ICT competency framework for teachers (CFT) version 3.0 (UNESCO, 2018)

	Knowledge Acquisition	Knowledge Deepening	Knowledge Creation
Understanding ICT in education	Policy understanding	Policy application	Policy innovation
Curriculum and Assessment	Basic knowledge	Knowledge application	Knowledge society skills
Pedagogy	ICT-enhanced teaching	Complex problem solving	Self-management
Application of Digital Skills	Application	Infusion	Transformation
Organization & administration	Standard classroom	Collaborative groups	Learning organizations
Teacher Professional Learning	Digital literacy	Networking	Teacher as innovator

At the micro-level, it is important to strengthen teacher ICT competencies from the pre-service teacher training. Lim and Pannen (2012) argue that pre-service teachers tend to adhere to traditional, teacher-centered practices, primarily relying on their experiences as a school student. When learner-centered methods of ICT integration are not reflected in the teacher training course, traditional teaching methods are likely to persist throughout the teaching career (Fishman, Davis, & Chan, 2014). Hence, prospective teachers need to acquire knowledge and skills necessary to integrate ICT into their teaching and learning, such as the use of various digital devices and contents, cultivation of digital literacy, and understanding the principles of learner-centered pedagogy.

TPACK represents the intersection of all three knowledge domains that teachers need to acquire: content, pedagogy, and technology. The recent publication by OECD states that there is a need to revisit how existing programs are structured to train teachers about teaching with new technologies. Evidence also suggests that in many Latin American countries, the accessibility and quality of professional development programs should be a major focus for policy intervention (OECD, 2020). TPACK, which involves teachers' understanding of the complexity of relationships among students, teachers, content, technologies, and practices, can be a relevant framework to restructure or redesign teacher training programs (Dalal, Archambault, & Shelton, 2017).

ICT in education in the Peruvian context

As a middle-income country in Latin America, Peru was facing issues and challenges concerning the quality of education and teacher capacity building commonly observed in developing countries pursuing economic development. Over the past decade, Peru has achieved rapid economic development and consequently achieved remarkable growth in education, such as the increase in school enrollment rates. In 2018, net enrollment rates were 96 % in primary

schools and 89 % in secondary schools (UIS 2018). Despite the impressive progress achieved in basic education, quality of education as measured by student achievement in international examinations continues to lag from the countries at a similar income level (Bos, Ganimian, Vegas, & Álvarez-Marinelli, 2014; Bruns & Luque, 2014). Overall, there has been loose coupling between education reforms (e.g., curriculum change, in-service teacher training, textbook distribution, student performance evaluation, etc.) and the improvement of educational delivery (World Bank, 2007).

Issues were consistently raised concerning the quality of education, especially the educational disparity due to income gaps between urban and rural areas as well as geographical barriers (e.g., mountains and jungles). The poor performance of teachers in Peru is widely recognized as one of the most important factors contributing to the low educational quality (Rivero, 2010). For instance, teachers are often absent from school, especially in the poor and remote areas where about 15 - 20 % of teachers are regularly absent. Contract teachers are absent more often than permanent teachers (Alcazar et al., 2004).

In Peru as well as other developing countries, ICT is viewed as a core element in education reform initiatives for expanding educational opportunities, improving the quality of education, and further for leading educational innovation and economic development. When integrating ICT into education, however, developing countries often face complex issues such as infrastructure problems (e.g., electricity and the Internet,) the lack of technical support, a diverse range of local languages, and the lack of teacher competency (Kozma & Vota, 2014). Peru, the case of this study, was also criticized for failing to produce the expected impact of ICT integration in education despite the government's investment and efforts. Such critics and voices toward educational reform were further strengthened with the experience of failing the One Laptop Per Child (OLPC) project, which was implemented on the largest scale in the world, and the fact that Peru remains at the bottom of the international comparison of student attainment such as PISA (OECD, 2015; Rollstone, 2014).

Methods

Overall process

This study was conducted for an ODA project on ICT in education in Peru through three stages: literature survey, site visit, and policy suggestions. First, the literature survey was conducted on the current status of ICT in education policy in Peru. At the time of the study, there were only a few articles and data about ICT in education in Peru available in the South Korean literature except for the *Latin American Educational Cooperation Study* published by the Korea Education Development Institute (Yoon et al. 2013; 2014). Therefore, we collected various reports and data on educational projects related to Peru published by international organizations such as the Inter-America Development Bank (IDB), UNESCO, and World Bank as well as the website resources. Second, the consulting team visited Lima, the capital city of Peru, twice to attend the International Working Group meeting. During the meeting, the team conducted interviews with the key personnel from the Peruvian Ministry of Education, the Office of Education in Lima, the South Korean Embassy, and the KOICA office in Lima. Third, the research team derived policy suggestions for ICT in education in Peru by synthesizing the data collected through the previous stages (i.e., literature survey and site visit).

Analysis method

Among the various policy suggestions made for ICT in education in Peru, this study focuses on the area of developing teacher ICT competencies. First, we used the data collected from the literature survey and site visit to understand the past and current situations of ICT in education in Peru. In the international development context, understanding the situation is an important step for external researchers to better understand the situation under investigation and to gain insights into the issue from multiple perspectives (C-Change, 2012). As mentioned earlier, we

collected various data and reports concerning ICT in education in Peru, and also conducted interviews with relevant stakeholders during the site visit to Lima. The collected information and data were used to identify various factors in the trajectory of ICT in education in Peru. Three main areas analyzed during this process include (1) the national ICT initiatives, (2) the teacher training system, and (3) the status of teacher ICT competencies.

Second, to draw policy suggestions about teacher ICT competencies, we employed the framework of the 'macro-meso-micro' level of the teacher professional development model proposed by Twining et al. (2013). The framework was chosen for this study because it helps draw policy suggestions that consider the intertwined relationships of multiple factors surrounding teachers. The framework underscores that the development of teacher ICT capacities should be approached as a continuous process from a systematic perspective. As shown in Figure 1, teacher competency development in this model is seen as a continuous and organic process in three stages: pre-service, in-service, and lifelong. The development of a teacher's competency to use ICT is influenced not only by micro (individual-specific) factors
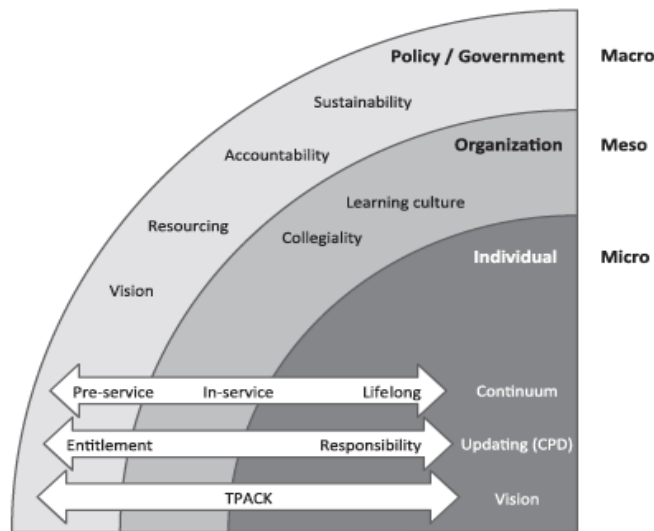

Figure 1. Three nested levels of teacher professional development
(Twing et al., 2013, p.431)

such as teachers' beliefs, motivations, and experiences of using technology but also by meso (intermediating) factors surrounding the individual teachers. Meso factors include both intangible and tangible dimensions such as the school's ICT infrastructure, school-level ICT utilization policy, the role of school leaders, and peer culture. Furthermore, the development of teacher ICT competencies is a complex phenomenon influenced by macro (socio-economic and political) factors, encompassing educational policy, national curricula, and socio-cultural beliefs and practices.

Results

Understanding the situation

In this section, we present the main issues that help to understand the situation of developing teacher ICT competencies in Peru. Three main areas drawn from the literature survey and site visit are (1) the national ICT initiatives, (2) the teacher training system, and (3) the status of teacher ICT competencies.

National ICT initiatives

In the Peruvian education system, education is compulsory in pre-primary (3-5 years old), primary (6-11 years old), and secondary (12-16 years old) levels. There are about 49,000 schools and 340,000 teachers. The number of enrolled students is about 4 million in primary schools and 3 million in secondary schools (UNESCO, 2019).

Historically, ICT was rarely integrated into the Peruvian education system. From 1996, small-scale ICT initiatives were implemented such as distributing computers and applications to schools that were primarily used for teaching basic-level ICT literacy skills. Currently, Peru is pursuing education reform following the new

policy called *Bicentennial Plan 2021.* This plan includes the establishment of regional teaching and learning centers to support the quality of education, and the 'Teach for Peru' program for college students and graduates to become teachers in underprivileged areas. The importance of ICT in education has been increasing as an enabler to support the achievement of the national policy goals. Based on this background, we discuss three main initiatives of ICT in education in Peru that are relevant to the subject of this study: (1) Huascarán Project, (2) Peru Educa, and (3) One Laptop Per Child (OLPC).

First, the 'Huascarán Project' was initiated in 2001 to build ICT infrastructure at elementary and secondary schools. This program aimed to expand learning opportunities by incorporating ICT, ultimately eradicating poverty in the local community with the help of education. Through this project, schools received various hardware and software programs. The priority of participation was given to schools in rural and poor areas. Teachers received some training to increase their ability to use ICT tools. For schools in need of technical support, an innovation room coordinator with competence in ICT and pedagogy was placed to help teachers.

Second, an e-learning platform called 'Peru Educa' (http://www.perueduca.pe) was launched in 2007 to provide educational opportunities to remote students. Students can use various multimedia materials in Peru Educa and learned many subjects such as physics, religion, history, economics, English, and mathematics. The Peru Educa service has been widely used, including 370,000 teachers and 140,000 students as well as principals, parents, and administrators. Peru Educa provided more than 100 online courses mainly updated by the Ministry of Education.

Third, Peru is known as the country with the largest distribution of the OLPC project (World Bank, 2012). OLPC is an initiative that aimed to distribute XO PCs known as a '100-dollar laptop' to children in the developing world. The OLPC project was ambitiously started to narrow both the digital gap and the education

gap, which were deepening in developing countries. The OLPC project was implemented in Uruguay, Peru, and Rwanda with the support of developed countries and IT companies. In Peru, 902,000 XO computers were distributed since the first release in 2008 (Cristia et al., 2012). This was the largest scale among the OLPC programs around the world. In line with the OLPC program's goal to benefit the most marginalized populations, the program was initiated from the most remote and poor areas of Peru, such as multi-grade schools and one-teacher schools (Severin & Costa, 2011). However, most of these schools had almost no connection to the Internet (e.g., only 1.4% of schools had internet connectivity), some with no electricity supply. This means that students had access to the content and activities that were pre-installed on the XO PCs.

On the whole, the three initiatives mentioned above show that the Peruvian government has invested and put efforts at the policy level to build the necessary infrastructure that facilitates ICT integration in education. Despite such policy efforts, the existing literature indicates that the effects of these initiatives were questioned and criticized. For instance, Huascarán Project received a negative evaluation concerning increasing the quality of education (Christia, Czerwonko, & Garofalo, 2014). While students acquired basic computer skills, this did not lead to positive effects on academic achievement. Due to technical problems and the lack of teacher competences, many schools had difficulty in integrating ICT into the curriculum. The OLPC project also received some negative evaluations from the longitudinal studies. Cristia et al. (2012) investigated the impact of an increase in computer use for about 15 months. Overall, the findings were not positive. There was no significant association found between the use of XO PCs, the school enrollment rate, and academic achievement in major subjects. In addition, Beuermann et al. (2015) studied the effect of the OLPC pilot program with 1,000 students in Grades 3-6 who used XO PCs installed with digital books and programs provided by the Peruvian government. After five months, however, the study revealed that while students who received XO computers used them more

frequently, there was no clear effect of the computer use on reading, mathematics, cognitive abilities, and ICT competency.

To summarize, the aforementioned initiatives did not meet the expected effects for improving the quality of education through ICT integration. This phenomenon is consistent with the previous studies, highlighting that expanding the access to technological tools alone is unlikely to bring in-depth changes in education (Ertmer 1999; Kozma & Vota, 2014). The fact that the Peruvian government supported large-scale ICT projects such as OLPC is a positive indicator. For more systemic changes, however, it is necessary to go beyond improving the basic condition such as access to computers and applications. To better integrate ICT for meaningful teaching and learning, more focus should be put in place to bring deeper pedagogical changes through supporting the capacity building of teachers as change agents.

Teacher training system

The existing literature has emphasized that improving the quality of teachers should be at the center of educational reform initiatives (Darling-Hammond & Bransford, 2007; Fishman et al., 2014). Nevertheless, since many developing countries are facing the issue of the shortage of teachers, it is difficult to cultivate teachers with adequate competence and qualifications. Peru has faced similar problems in both the shortage of teachers and the lack of qualified teachers.

One of the important reasons for the decline in the quality of public education in Peru can be attributed to the systems issue concerning how teachers are trained and placed in schools. Since there are no clear guidelines from the government regarding the teacher education system, each university and institution designs and operates their programs differently. In Peru, teacher training is largely conducted through three institutions: formal teachers college, ISP (Institutos Superiores Pedagogicos), and artistic training college. About 63% of teachers are trained by ISPs, which is an informal teacher training school (Mateus, 2018). As many

under-trained teachers who graduated from ISPs were placed in schools, it led to the decreasing quality of public education. The Peruvian government, hence, prepared some mechanisms to prevent the oversupply of teachers from ISPs. The mechanism included the upgraded standards for admission to ISPs such as conducting a separate interview and more rigorous standards for graduation such as passing a written test. Since 2007 when such strict admission and graduation systems were implemented, the number of teachers from ISPs decreased significantly. However, strengthening these standards caused another problem, a shortage of teachers in specific regions.

Teacher ICT competencies

As the Peruvian Ministry of Education announced a plan called the *Digital Intelligence Model in Education towards 2030* in November 2016, ICT is expected to accelerate the future of Peruvian education. Accordingly, fostering teacher ICT competencies has emerged as a top priority under this policy direction. The existing literature, however, indicates that the level of Peruvian teachers' ICT competencies is not high and that teachers did not receive adequate training in ICT integration for teaching and learning. For example, a large-scale study conducted by the World Bank observed lesson implementations in schools in Latin American countries and published the report *'Great Teachers: How to raise student learning in Latin America and the Caribbean'* (Bruns & Luque, 2014). The study was conducted in more than 15,000 classrooms of 3,015 schools in seven countries in Latin America. In Peru, 1,828 classrooms in 668 schools participated in this study from 2011 to 2012. The study found that while Peru was the country that invested the most in personal computers among the seven countries, the ICT usage time out of the total class hours was the lowest. Another study found that three schools supplied with XO PCs during the initial implementation of the OLPC project did not provide adequate ICT training to teachers (Ortiz & Cristia, 2014). Even more, the number of teachers never received any form of training. That is, XO PCs were provided

without proper teacher training to support meaningful integration in classrooms. Taking these facts together, teacher ICT competencies appears as an important factor that influenced the success and failure of ICT in education projects in the Peruvian context.

Policy suggestions

As the last step, policy suggestions were drawn for improving teachers' ICT capacity in Peru under the overarching goal of improving the quality of education and meaningful ICT integration in schools. As shown in Table 2, we analyzed the current level (As-Is) and the desired level (To-Be) based on the framework of the 'macro-meso-micro' level of the teacher professional development model proposed by Twining et al. (2013).

Table 2. Policy suggestions for teacher ICT competency development

	AS-IS		TO-BE
Macro	• No national-level ICT competency framework for teachers	→	• Developing a national-level ICT competency framework for teachers toward knowledge deepening and creation
			• Providing competency-based ICT training tailored to the level and needs of individual teachers
Meso	• Lack of bottom-up initiatives from teachers	→	• Promoting a culture of information sharing among teachers in teacher communities
			• Supporting school-based research programs
Micro	• Lack of knowledge and skills for integrating ICT in teaching & learning	→	• Cultivating teachers' capacities for ICT integration based on the TPACK framework

Macro-level: Developing a national-level teacher ICT competency framework

Overall, our analysis suggests that there is a critical need to develop a national-level framework of teacher ICT competency standards and evaluation systems to implement a systematic teacher training model. Various approaches can

be considered to develop the framework for teacher ICT competency at the national level. In the report '*Developing and implementing competency-based ICT training for teachers*' (UNESCO, 2016b), three approaches are introduced with relevant country cases, namely: (1) ICT competency as an integral part of the overall teacher standards (Australia), (2) developing new ICT competency standards (South Korea), and (3) adapting the existing ICT competency framework (Kenya and Tanzania). Table 3 presents the advantages and disadvantages of each approach.

Table 3. Comparison of the advantages and disadvantages of the teacher ICT competency development approaches (UNESCO, 2016b)

	Advantages	Disadvantages
Approach 1 Including ICT in the existing teacher competency standard (Australia)	• Meet general competency standards • Teacher education and training institutions can apply easily	• Rely on more established universities and educational institutions
Approach 2 Developing new competency standards (South Korea)	• Maximize teacher engagement and ownership	• High cost and time consuming • Technical expertise required
Approach 3 Adapting the existing frameworks (Kenya & Tanzania)	• Cost and time efficiency	• Lack of ownership

First, Australia included ICT competences as an integral part of the overall teacher competency framework. In this case, since the ICT competency framework has some levels of flexibility, institutions that conduct teacher education and training can modify the framework to suit their purpose and needs. On the other hand, due to its high flexibility and independence, this approach relies highly on the expertise and experiences of the institutions that conduct teacher education and ICT training. Second, South Korea developed new standards for teacher ICT competencies under the policy framework of SMART education by profiling

competencies through a Delphi study method. Exemplary teachers in ICT integration also participated in the development process and the initial framework was pilot-tested before developing the final set of teacher competences in ICT and SMART education. This approach provides strong ownership to the body that leads to the development of the ICT standards, which allows the development of contextually-relevant and policy-consistent standards. The disadvantage, however, is that it requires high cost and time to complete the whole process. Third, adapting existing competency frameworks saves significant time and cost compared to developing new standards. For instance, to enhance ICT competences to teach STEAM (Science, Technology, English, Arts, and Mathematics) education, Kenya and Tanzania adapted the UNESCO's ICT CFT as a major framework.

Among the various approaches mentioned above, a development approach should be adopted by considering key factors such as the socio-economic situation in each country, the direction of a long-term education policy direction, and the current status of teacher ICT competencies. Considering that there are some established frameworks on teacher ICT competencies, our policy suggestion is that the Peruvian government adapts and localizes the established framework rather than developing new standards. The importance of educational policy for teacher ICT capacity building in Peru should be embedded in the framework of the national ICT in education master plan. Since the Peruvian government focuses on improving the quality of education, the standards for the ICT competencies should focus on the vision toward knowledge deepening and knowledge creation (UNESCO, 2016b). That is, the purpose of integrating ICT needs to be viewed as the enabler to promote students' higher-order thinking skills and other 21st century skills.

Figure 2 is a schematic diagram of the procedure that the Peruvian government may take to develop the standards for Peruvian teachers' ICT competencies. The first step is to form a group of experts to comprehensively review the existing ICT competency frameworks for teachers used in other countries with similar socioeconomic backgrounds, and then to categorize competency standards

appropriate to Peru's current situations such as the pre-service teacher training system and the existing teacher professional development models. The second step is to validate the initial competency framework drawn from the first step. In particular, it is advised to involve both exemplary teachers in ICT integration and teachers in under-resourced areas in order to increase the fidelity of the framework in diverse situations and practices. In the final stage, an expert group is to revalidate and establish the final competency framework. Through this process, it is expected that a national-level framework for teacher ICT competencies can be systematically developed, reflecting the local situation of Peru as well as enhancing the applicability of the developed framework.
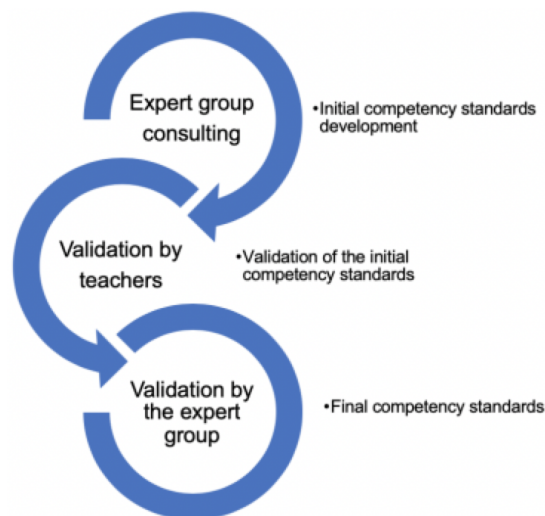

Figure 2. Process of developing national-level ICT competency for teachers framework

Meso-level: Promoting teacher community and school-based research programs

The recent literature in teacher education has highlighted building a culture of knowledge sharing among teachers in informal spaces outside of schools as an important mechanism for professional development (Darling-Hammond &

Bransford 2007; Fishman et al., 2014). We, however, found that there is currently a lack of platforms and support systems for sharing knowledge and information about ICT practices among Peruvian teachers. During the site visit, the officials from the Ministry of Education recognized the importance of promoting teacher-communities where teachers share innovative teaching and learning methods using ICT.

Our policy suggestion, hence, is to leverage the existing online platform such as PeruEduca and social media services to promote the community for teachers. Since many Peruvian teachers are already using the PeruEduca service, it would be relatively effective to reach out to a wide range of teachers located in diverse areas across the country. Teacher research communities in Korea can be an exemplary case that Peru can learn from to promote teachers' sharing of ICT practices. A teacher research community is a bottom-up initiative where Korean teachers in the regional areas gather to develop and share ideas for ICT-integrated lessons. Best ICT practices are shared among the teachers in the research community. Teachers also participate in various activities such as workshops, seminars, and lesson study through the research communities. Besides offline gathering, there are also online research communities through social media, which overcomes the limitation of geographical barriers. Teachers join online communities of their interest and ICT practices are shared on the social media. Through such bottom-up approaches for promoting participatory culture in offline and online communities of teachers, policy messages can be cascaded to the diverse levels, ultimately impacting the practice level.

From the systems perspective, the meso level plays a critical intermediating role in linking the macro factor (e.g., national ICT policy) and the micro factor (e.g., individual teachers). Teacher educators, researchers, and research institutions are important meso-level actors by translating and implementing national policies to schools. Hence, we suggest that Peru can further promote school-based research programs for research and practice nexus. For instance, the Ministry of Education

can develop a program that particularly supports school-based research studies where researchers from universities work closely with teachers to implement ICT projects in schools. Since researchers can translate policy goals and actions to teachers, policy messages are better delivered to the ground level, impacting practices in schools.

Micro-level: Enhancing teachers knowledge and skills in ICT integration

One of the biggest problems with Peruvian teacher ICT competencies is that teachers do not receive systematic ICT training. It was reported that less than 50% of teachers received ICT-related training (Ortiz & Cristia, 2014). Although Peru had the highest investment in 1:1 computing among Latin American countries through the OLPC project, the study by Bruns and Luque (2014) found that the percentage of time spent using ICT among the total class hours was the lowest (about 1%) among seven countries in Latin America and the Caribbean.

As the Peruvian government recently announced the *Digital Intelligence Model in Education toward 2030* plan, the enhancement of teacher abilities to use ICT has emerged as an urgent task. However, since most of the currently offered ICT training appears to focus on the media literacy of using technological tools, teachers lack the knowledge and skills necessary for integrating ICT in pedagogically-sound ways. For more meaningful integrations of ICT, our policy suggestion is to redesign teacher training and professional development programs not only to increase teachers' basic ICT literacy skills but also to enhance their pedagogical knowledge and application skills. We suggest the 'Technological Pedagogical Content Knowledge (TPACK)' (Mishra & Koehler, 2006) framework as a theoretical base to design ICT courses and programs offered to teachers. TPACK is a framework of the teachers' knowledge base particularly relevant to the situation where the emphasis is to go beyond the basic level of ICT usage and to promote more meaningful integration of ICT within the curriculum. TPACK questions the general decontextualized ICT courses and training that do not help teachers connect content and pedagogy with ICT tools. Mishra and Koehler (2006) argue that for

teachers to effectively use ICT, content knowledge (CK), pedagogical knowledge (PK), and technological knowledge (TK) must not exist separately. They argued that teachers need TPACK that connects the three types of knowledge organically and in an integrated manner.

TPACK-integrated pre-service teacher training programs have been successfully implemented in Australia, Singapore, Kenya, and Tanzania. For instance, the National Institute of Education in Singapore, which is the only teacher education institution in Singapore, has restructured the ICT courses for all pre-service teachers to follow the idea of the TPACK framework. Tanzania employed TPACK as a central direction in designing teacher training modules at the national level (UNESCO, 2016b). As mentioned earlier, Tanzania used UNESCO's ICT CFT as a macro-level framework to develop the teacher ICT competency standards. Teacher competency levels are divided into four levels: 1) emergent, 2) applying, 3) proficient, and 4) transformative. Similar to the Tanzanian case, we suggest that Peru can adopt TPACK as a theoretical framework to design teacher ICT training courses and programs. It is important to consider that the direction in designing teacher training courses should reflect the national-level framework of teacher ICT competencies. To design teacher ICT training modules consistent with this macro-level framework, Peru can adopt TPACK to guide teachers for designing teaching and learning activities with ICT. At each stage of teacher training modules, teachers can learn pedagogical, content, and technological knowledge, and then apply TPACK to design class activities and materials. During the professional development programs, teachers can understand the relationship between the national level of ICT competency standards and the training model that they experience from the concept of TPACK.

Discussion and Conclusion

This paper aims to present policy suggestions concerning how to foster teachers'

ICT competencies in the context of developing countries using the ODA project in Peru as a particular case. As many developing countries consider ICT as a key enabler to improve their educational systems, there will be increasing demands from developing countries to learn from the South Korean experience of ICT in education policies and projects. Indeed, for the past decades, South Korea has achieved remarkable progress in promoting ICT integrations in schools, through the systematic implementation of the ICT in Master Plan policy, the establishment of various agencies and institutes to support policy actions, and the development of online platforms. From the trajectory of the ICT in education policy in South Korea, the key lesson learned is the importance of building teachers' capacity to design and implement meaningful ICT practices.

The same lesson goes to both Peru and other developing countries that position ICTs as a key enabler to lead changes in teaching and learning practices. In Peru, although the world's largest OLPC project was carried out with the wide distribution of XO computers to schools, the research studies on the effects of the OLPC project commonly indicate that ICT integration was at the basic and superficial level and did not lead to the fundamental changes to improve the quality of education. In the future, it is necessary to establish ICT in education policy actions from a long-term perspective where the use of ICT is viewed as a mechanism to resolve the fundamental issue of the Peruvian education system such as the educational disparity between urban and rural schools, and between public and private schools. Teachers play a critical role in pursuing such changes in ICT-integrated education for the improvement of the quality of education.

Hence, this study presented macro-, meso-, and micro-level policy suggestions for enhancing teacher ICT competencies drawn from the literature survey and the site visit. At the macro level, we suggest the development of the national framework of teacher ICT competencies and the need to design competency-based ICT training programs. At the meso-level, our policy suggestion is to promote teacher communities of practices where teachers can share their ideas, knowledge,

and practices to spread innovative practices with ICT. Lastly, at the micro-level, we suggest that the direction is to redesign teacher training and professional development programs to help teachers better understand the complex relationships between content, pedagogy, and technology, beyond learning about basic ICT literacy skills, in order to elicit students' high-order thinking skills through the use of various ICT tools.

The policy suggestions and implications in this paper can be applied to other developing countries that are facing similar challenges with the lack of teacher ICT competency development policy. First, in the field of ICT in education, ODA projects from the international community have mainly focus on building infrastructure. Beyond stand-alone infrastructure support projects for improving the educational environment in developing countries, it is essential to build a close connection between the curriculum for teacher training and teacher training policy from the national and institutional levels. This suggests that from the initial planning stage of the ODA project, it is important to have in-depth understanding of macro policy environments and micro-level situations about teacher ICT capacity building.

Second, there should be tight monitoring of the goal and impact of various ODA projects targeting teachers' ICT capacity building. Through this project, we found that there were various ICT in education projects in Peru from the donor groups such as World Bank, Inter-America Development Bank, UNESCO, and other global ICT enterprises. For such projects to have sustainable impacts rather than remaining as fragmented initiatives, each project should be comprehensively promoted within the Peruvian government's policy on teacher training and curriculum.

Third, while this study focuses on the capacity building of in-service teachers, digital literacy education should be strengthened from pre-service teacher education. The new direction of ICT education for teachers lies primarily in the development of a set of adaptive and transferable knowledge and skills so that teachers are better

able to adapt to the challenging and complex nature of future learning environments. Therefore, the design of ICT courses for pre-service teachers has to move beyond learning about technical skills and to focus on doing with understanding where pre-service teachers are continuously exposed to better understand the complexity of teaching and learning with technology, and to develop systematic and creative thinking skills for innovative ideas to grow.

The limitations of this study should be noted. First, this study was based on the relatively limited literature, resources, and data on the current status of Peru's ICT in education policies. Since many reports, articles and data are available in Spanish or outdated, the research team had difficulty finding relevant recent resources. The interpretations of the key findings, thus, should be carefully made with the consideration of this limitation. Second, we relied on the interviews with policymakers at the Ministry of Education and Office of Education officials and did not have the opportunity to interview Peruvian teachers. In the future, it is necessary to capture the voices of teachers by collecting data on the direction of ICT in education policies perceived by Peruvian teachers. Third, Peru is considered as an upper-income developing country. Hence, some policy suggestions may not be relevant to the low-income developing countries that struggle with building the fundamental ICT infrastructure and with limited resources for teacher training.

Despite these limitations, the contribution of this study is that through the case of the ODA project in Peru, it presents issues about ICT in education policy in Latin America, which has been rarely known in the South Korean context. It is expected that the main ideas of this study will be used as basic data for promoting international cooperation and partnership between South Korea and Peru in the future.

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