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Exploring Different Needs of Digital Immigrant and Native Teachers for Technology Professional Development in China

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This study examined if professional development needs of digital native and digital immigrant teachers differed in order for them to successfully integrate technology into teaching in the Chinese education setting. Quantitative and qualitative data were collected from 500 teachers in six schools in the southwest of China. The digital native teachers and the digital immigrant teachers were compared in terms of their different technology use behaviors and integration skills. The findings indicated that even though the digital native teachers had greater comfort with basic technology than the digital immigrant teachers, they still required training for integrating technology effectively in their teaching. The digital immigrant teachers needed more basic technology operations training as well as connections between technologies and teaching. Future technology professional developments in developing countries should 1) consider the different needs of digital native teachers and digital immigrant teachers; 2) prepare them to make meaningful connections between technologies and their teachings; and 3) adopt individual coaching with on-site designated specialists.

Keywords: Educational technology; digital native; digital immigrant; professional development

INTRODUCTION

Teachers have been identified as the key players in effective integration of technology in teaching and learning (Li, Worch, Zhou, & Aguiton, 2015). They have been tasked with the goal of integrating technology into their classrooms and curriculums in order to improve teaching quality. However, teachers have not been well prepared to take on these

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important tasks (Salmon, 2013). Researchers have suggested that professional development (PD) was one of the most effective ways to help improve teachers' technology integration abilities (Peterson & Palmer, 2011). However, a significant amount of current PDs were ineffective (Gemeda, Fiorucci & Catarci, 2014). Researchers pointed out that technology PD should consider the digital generation gap because teachers of different ages have different experiences and technology abilities (Leary, Lee, & Recker, 2014).

China is a developing country in Asia with centralized authority system. The Chinese state-run public mandatory nine-year compulsory education system includes two phases: primary (grades 1-6) and secondary (grades 7-9). In recent years, China has got great achievement in educational technology development, but extremely unbalanced. In the east, development level is competent to developed countries in the world. In the west, it is extremely under-developed. The development in the southwest of China is in the middle level of its overall nation, which can more accurately reflect the level of developing country. In 2014, the Chinese Ministry of Education issued a regulation titled *Implementation and promotion use of the technology for primary and secondary Chinese teachers*. This regulation requires that, every year, every teacher in public schools must attend at least one teacher professional development program to increase their technological skills, and their technical skills must be assessed at least once a year. Considering the on-going impact of this policy and the peculiarities of the Chinese public education system, it is necessary to examine the needs of professional development for different generational groups of teachers, and enhance the effectiveness of the national regulation.

A line of research on digital generation gap has accumulated in the US (Hanning, 2015; Helsper & Eynon, 2010; Lei, 2009; Ransdell *et al*, 2011; Watson, 2013; Wyk, 2015); however, not much research has been conducted in the Chinese education setting. Studies of comparing and contrasting between cultures on the topic are insufficient but quite in need. China as one of the biggest developing countries in the world needs to know what challenges that are already found and to some extent met in the developed countries, there is also a need to understand which additional challenges, if any, there may be existed in the country. Hence, it is necessary to use the Chinese sample to explore the digital generational differences, and further explore how current professional development could be developed in order to fit the different generational needs in developing countries which share the similar culture with China.

LITERATURE REVIEW

The concept of digital generation gap was first proposed by Prensky (2001a), who identified two demographic groups based on the level of technology immersion. The digital natives were people born after 1980, grew up immersed in technologies, and thus possessed a high level of ability to use technologies; and the digital immigrants were those born before 1980, grew up without modern information and communication technologies and as a result lacked the experiences and or ability to use technology (Prensky, 2001a; Ransdell, Kent, Gaillard- Kenney, & Long, 2011). Prensky (2001b) pointed out digital natives were comfortable, confident, and more positive towards technology use than digital immigrants because they grew up with easy access to computers, the Internet and other ubiquitous ICT devices. On the other hand, digital immigrants have seen an emergence of new technologies, and had to interact with them later in their lives. They learnt to adapt the new technology environment, and they retained, to some degree, their traditional habits (Prensky, 2001b).

Based on our literature review, commonly there are two thresholds defining digital immigrants: age and accessibility. On one hand, a generational boundary on age in

empirical literature (Bannon & Thomas, 2014; Bowe & Wohn, 2015) was followed by the of Prensky' definition (2001a). Thinyane (2010) contended that students who were born before 1980 can be classified as the digital natives for their access to basic technologies in South African, such as emails mobile phones, and desktop computers. On the other hand, Kennedy *et al*. (2008) suggested that it was not quite appropriate to simply distinguish digital natives by age, considering some people in underdeveloped areas did not have access to technology equipment, and their digital skills were not improved with their growth, even if they were born after 1980. Thus, accessibility to technological equipment was introduced to differentiate between digital natives and digital immigrants. However, empirical studies also showed that accessibility could not guarantee use of technology (Lei, 2009). Furthermore, some other factors were considered to picture the two generational groups, such as experiences when they interacting with technology (Tapscott, 2009), socioeconomic status (Ferro *et al*. 2011), regional development level (Helsper and Eynon, 2010), computer self-efficacy and experience (Teo, 2015).

Even though there are various ways to define the digital natives and digital immigrants, the generation gap does exist (Prensky, 2001a, 2001b), and the gap seems also exist among teachers. Based on Prensky's claims (2001a, 2001b), lots of studies have used empirical data to supported this contention. A study conducted with 68 college students and 79 faculty members (Salajan, Schonwetter, & Cleghorn, 2010) found there was a generational difference between the perceived usefulness and importance of digital technologies for learning and teaching. Further, a study with 1,121 inservice teachers and 245 pre-service teachers in Kentucky and Tennessee revealed that the digital native preservice teachers were more supportive of the use of mobile phones in the classroom, more positive about the useful features, and had less concern about the barriers associated with using phones for school-related work (Thomas & Bannon,2015). In Kinash & Wood (2013)' study, when asked about what technologies have been used in schools, the digital immigrant teachers talked about chalkboards and overhead projectors, while the digital native teachers' answers not only included laptops and smart phone, but also technologies with complex instruments and procedures, such as programming languages and rocket simulators (Kinash & Wood, 2013).

Conversely, Bennett, Maton, and Kervin (2008)' study revealed that digital natives constituted a heterogamous group regarding technological skills, attitude, or learning style. The study resonated with Lei's study (2009) that, while these digital native pre-service teachers generally had strong belief and confident in technology, and most of them spent more than 2 hours on computers per day, they lacked advanced technological skills associated with teaching. In a similar vein, Metallo & Agrifoglio (2015) found that digital native teachers felt computers were easier to use – but less useful. Ransdell et al. (2011) suggested that although digital immigrant teachers had less confidence in technology use, they were able to apply what they learned about technologies better than digital natives. As long as digital immigrant teachers had enough time and accessibility, they could learn technologies as well as digital natives and become true digital natives.

As the first generation of digital natives in China have grown up and entered the workforce, digital native and digital immigrant teachers worked in the same technology environment (Puybaraud, 2012). The situation calls for research to determine if digital native teachers differed from digital immigrant teachers in Mainland China---a developing country. If there is a significant difference, Chinese government can pay more attention to provide targeted professional development. The purpose of the study was to investigate: (1) if there were any differences between digital native teachers and digital immigrant teachers in China regarding general technology use information, such as first time access to technology, time spent on technology, attitudes and beliefs toward technology, and other

technology activities; (2) what technology PDs were needed for digital native teachers and digital immigrant teachers specifically.

METHODS

RESEARCH DESIGN

This study employed mixed methods research design which included an initial quantitative questionnaire and a follow-up interview. The qualitative results were crosschecked with the quantitative results and helped deepening understandings of the quantitative findings (Creswell, 2002; Johnson & Onwuegbuzie, 2004)

SAMPLE

The study utilized a stratified sampling method to collect data from teachers in the southwest of Mainland China in 2016. The strata used for the stratified sampling was the teachers' working location. The sampling frame included all schools in all provinces in the southwest of China. The research team randomly selected the provinces, and schools within the provinces were randomly selected from the database. A total of 500 school teachers were selected from eight schools (three primary and five secondary) in the southwest of China in 2016. They taught all courses required for compulsory education in China, including Chinese, math, English, science, history, and technology.

In this study, we still use the age as a threshold to define the Chinese digital native and immigrants for its convenience in sampling and filtering. Here we use two evidences as the bases for judgments. First, age is popular cut-off to distinguish the digital native and immigrants, not only in the developed countries but also in the developing country (Thinyane,2010). Thinyane (2010) claimed that digital natives were a world-wide phenomenon. Even though there are different forms for technology use in different countries, since the 1980s, information technology, such as computers, mobiles, and the Internet, have been affecting the people world-wide. Second, the technology development in Asia-Pacific region started with Japan in the 1960s and 1970s, and continuing with Singapore, Korea, and Taiwan in the 1980s. With Chinese policy "Reform and Opening" in 1978, computer hardware was imported to mainland China from overseas in 1980s. Therefore, we assume that the cut-off year 1980 defined by Prensky (2001a) and Ransdell *et al.* (2011) is still reasonable for this research. Digital natives were defined as those who born after 1980, and digital immigrants were those who born before 1980 in this study. There were 166 digital native teachers and 334 digital immigrant teachers in this sample. Descriptive statistics for the digital native and digital immigrant teachers are presented in Table 1.

MEASURES AND ANALYSIS

Questionnaire

A Chinese version of self-report questionnaire was used for this study. Items were adapted from published sources (Lei, 2009; Teo, 2011; Tackett, 2014). Back translation techniques were used to make sure the word accuracy. The questionnaire was piloted with 120 school teachers recruited from the same area and a few minor revisions were made to the questionnaire afterwards. The finalized questionnaire yielded an appropriate psychometric property with high reliability for each latent construct, and the details were in Table 2. The survey included two sections. The first section included general technology use information, such as first time access to technology, time spent on technology, attitudes and beliefs toward technology, and other technology activities. Questions in this section were multiple-choice questions. Items were rated on a five-point Likert scale, ranging from

1-strongly disagrees to 5-strongly agree. The second section evaluated teachers' technology proficiency with 41 specific common technologies measuring by a scale of 1-5 with 1-beginner and 5-expert. Detailed description was given for each category. For example, being a "beginner" means having little to no skills, and being an "expert" means being able to teach others how to use and create/customize the application, or to teach others how to perform the task. The difficulty level of these 41 technologies was rated by five experts: one educational technology administrator, two educational technology faculty members, and two technology support staff members in the IT department. Each person rated the technologies independently. An average rating was obtained for each technology by taking the mean of the ratings. Based on the ratings, these41 technologies were grouped in four categories: basic technologies, lower intermediate technologies, upper intermediate technologies and advanced technologies. By divide the technology proficiencies into four categories, we can assess the interaction effect between technology proficiencies versus digital generations. Quantitative data were analyzed using descriptive statistics; the Likert responses were regrouped and analyzed by odds ratio test; and the mean of proficiency responses were analyzed by one-way ANOVA and MANOVA.

Individual Telephone Interview

After the quantitative data analysis, the researchers grouped the participants into four groups based on their technology proficiency: basic, low, medium, and high. In each group, the researchers purposefully selected one digital immigrant and the other digital native teachers if they had agreed to participate in the follow-up interview in questionnaire and if their technology proficiency scores were mostly close to their group means. The ten selected participants were from 3 schools in the southwest of China, taught different subjects including Chinese, math, English, science and technology. The interview protocol was designed based on the questionnaire results. Participants were individually interviewed about their attitudes toward technology, challenges of integrating technology to teaching, and what contents and in which format they wish to have in future professional development by telephone. The average interview time was 10 minutes. All interviews were tape-recorded, transcribed, and analyzed to help understand the quantitative response.

RESULTS

Firstly, the odds ratio tests were performed to answer the research questions 1: if there were any differences between digital native teachers and digital immigrant teachers in China regarding general technology use information, such as first time access to technology, time spent on technology, attitudes and beliefs toward technology, and other technology activities. Secondly, the odds ratio tests, one-way ANOVA, MANOVA, combined with interview were performed to answer the research question 2: what technology PDs were needed for digital native teachers and digital immigrant teachers specifically.

DIGITAL NATIVE TEACHERS BETTER WITH TECHNOLOGY, LACK OF INTEGRATION ABILITY

Access to Technology Earlier, Spend More Time, Feel More Positive and Easier to Use

As shown in Table 2, firstly, 92.17% of the digital native teachers versus 38.82% of the digital immigrant teachers reported that they first accessed to technologies in high school or earlier. The results revealed that there was a significant generational difference in the first time of technology access (odds ratio=18.82, $p<.001$). It means digital native

teachers first time access to technology in high school and earlier/ digital native teachers first time access to technology after work was 18.82 times higher than digital immigrant teachers first time access to technology in high school and earlier/digital immigrant teachers first time access to technology after work. Secondly, the majority of digital native teachers (56.02%) reported having spent at least 2 hours per day in using digital technologies, while only less than half of the digital immigrant teachers (46.11%) reported on this option. Digital native teachers spent significantly more time with digital technologies than digital immigrant teachers (Odds ratio=1.49, $p<.05$). Thirdly, significantly more digital native teachers than digital immigrant teachers reported that they liked working with technology (75.67%versus 68.32%). Fourthly, significantly more digital native teachers perceived technology easy to use (Odds ratio=2.06, $p<.001$), their interaction with technology not taking much efforts (Odds ratio=1.52, $p<.05$), and have already met the national standards of technology use (Odds ratio=1.68, $p<.01$).

Responses from interview further confirmed the finding that digital native teachers maintained a more positive attitude and felt easier towards technology use than digital immigrant teachers. One digital native teacher stated:

> It is amazing how technologies have changed the way we live and work. Using technologies can save me lots of labor work in my work. I cannot live without a smart phone, Internet, and computer.

Another digital native teacher stated:

> Technological skills are very important for personal and social development in modern society.

On the contrary, statements given by digital immigrant teachers appeared less positive. A digital immigrant teacher stated:

> Technology could be a fancy tool nowadays, but…mm... Learning how to use technology in teaching and training programs related to technologies have taken me too much time so that I barely have time to communicate with my students.

The perceived easier uses of technology for the digital natives were also reflected in interview. Most of the digital natives except a few from rural areas considered that most of the time they could fix the technology problems, while most of the digital immigrant teachers indicated that technology skills itself was an important factor that hindered their use of technology in teaching.

Inability to Integrate Technology in Class

As shown in Table 3, findings indicated that digital native teachers used technology significantly more for entertainments, social networks, shopping, and class preparation, while digital immigrant teachers used technology significantly more frequently for work email, creative work, and learning for work related knowledge. Similarly, though the digital native teachers maintained better technology ability and more positive attitude, they still had concerns over the technology's usefulness for teaching. From digital native teachers: "*My students did not have time to take notes if I used more technologies in class*," and "*It was easier for students to copy other people's work if I have them finished the electronic version of homework*."

In a similar vein, no significant difference on overall teachers' integrating ability was detected in this study. Teachers in both groups claimed that they lacked teaching-related technological skills; they did not know where to find teaching-related information online; and they did not understand how to design lecture structure with technologies integrated.

The findings were something new from previous research. Digital native teachers were better with technology in general; however, they were not as good as digital immigrant teachers in using technology for teaching purposes. Even though digital native teachers grew up surrounded by technology, their teachers did not use much technology to teach during their K-12 schooling. It was not surprising that they did not have much experience with subject-specific technologies and learning-centered technologies, and therefore they continued their habits of using technology mainly for simple personal things after worked. (Berman & Delesha, 2014). As a digital native teacher noted:

> I do not know how to realize the potential benefits of technology within her classroom. I know Geometer's Sketchpad, but had no idea how it could be used to help improve students' space imaginary abilities in the teaching of geometry.

Similar ideas have been indicated by the other seven interviewees. The findings implied that technology professional development could be differently designed for the two groups. The digital native teachers might need even more help with guiding them use technology for teaching, while the digital immigrant teachers might need more help with basic technology operation skills. The both groups held reserved attitudes towards the usefulness of technology for teaching meant that they both needed trainings to help them conduct meaningful integration and further realize the positive effects of technology impact on teaching.

NEED TRAINING OF TECHNOLOGY KNOWLEDGE FOR BOTH

As shown in Table 4, digital native teachers performed significantly better than digital immigrant teachers in their technology proficiency. In addition, the effect size d for the basic level technology was 0.71, while decreased into 0.44 for advanced level, which meant generational gap became smaller as technology difficulty level increased. The findings implied that PD could take participants' prior technology knowledge into considerations, and give high achievers more opportunities to learn higher level technology knowledge.

PD NEED TO IMPROVE

As shown in the bottom of Table 2, significantly more digital native teachers than digital immigrant teachers received technology professional developments in the last 3 years (66.27% versus 59.58%, Odds ratio=1.33, $p<0.01$). This was probably due to the regulation in China that all the teachers aged before forty were required to participate in technology training, while not required for older teachers. As shown in Table 5, the popular training form and duration of trainings were mainly less than a one-week lecture (87.99%), followed by distance online training (50.97%), and project-based training (14.4%). More digital native teachers than digital immigrant teachers participated in the distance online training and project-based training.

The dominant lecturing training was not considered effective enough. Only 9% of the digital native teachers and 10% of digital immigrant teachers indicated that the training that they had received was very helpful. Teachers' open-ended responses and interviews revealed that technology knowledge taught in class played little role for them to apply it at work. Participants reported that they could understand what teachers demonstrated during the training class but could not remember it afterwards. One digital native teachers stated: *"I wish to have more*

practical classes and have them spread out to our real class." Another digital immigrant teacher stated:*"I would just say more hands-on, especially using technology in all the classes… I wish I could pair with a young teacher to learn technology in PD, in case I lost in class. Lectures usually are too busy to help me in class. Usually, the young teachers can give me a hand to some extent."*

Most of all the participants said in a similar way. The finding indicated that both native teachers and immigrant teachers preferred one-to-one mentoring, peer collaboration, and hands-on training format. Several participants indicated that one-on-one approach provided them flexible and immediate support, and thus maximized benefits of the support received. Collaborative group was also effective for them to apply integration knowledge in practice. This argument was congruent with most recurring findings in literature (Forte & Flores, 2014; William, 2010) that participants in collaboration were able to seek out peer sharing and support in and outside of training sessions, and the collaboration allowed them for more comfort and confidence in learning and practice knowledge of technology integration. Group project training format was an effective way to implement collaboration in teacher professional development, but this format accounted for the least share of market (19.09% for digital natives and 12.06% for digital immigrants, see Table 5). Digital native teachers participated significantly more in distance online training form (Odds ratio=1.30, $p<0.01$) and also in project based training form (Odds ratio=1.75, $p<0.05$). This might partially explain the reasons why digital native teachers expressed less negative attitude towards the effectiveness of the current training program. About 3% of the digital native versus 5% of the digital immigrant teachers reported that the trainings were not helpful at all for developing their teaching abilities.

Although the current PDs were not effective enough, teachers' intentions to improve their technology abilities were not discouraged. Over 96% of the teachers in both groups showed that they would like to participate in PDs in the future (Table 2).

SUMMARY

The findings indicated that the digital native teachers in this study accessed technologies earlier, spent more time on technologies in their daily life, held more positive attitude, perceived technologies easier to use, but the digital native teachers did not use technologies specifically for teaching and learning purposes. Even though the digital native teachers were savvy with basic technologies, they did not outperform digital immigrant teachers in technology integration in teaching. Both of them lacked experiences and expertise to work with advanced technologies and they both needed training for technology integration knowledge. Digital immigrant teachers needed additional basic technology operations skills. The two groups of teachers reported that they were not satisfied with the quality of the technology professional developments in which they have participated. They indicated that they did not like large-size lecturing while preferred one-to-one or small-size class training and hands-on training format.

DISCUSSION AND CONCLUSIONS

This study utilized questionnaire and interview data to uncover the generational gap, and further explored teachers' different needs in PDs in China. This section recaps the main findings and discusses the implications for practice and research.

"INTEGRATION" ABILITIES ARE NEEDED FOR BOTH DIGITAL NATIVE AND DIGITAL IMMIGRANT TEACHERS

Digital native teachers reported access to technologies earlier, spending more time on technologies in daily life, holding more positive attitude, and easier use of technology compared to the digital immigrant teachers. However, their perceptions towards the usefulness of technology for teaching were somewhat reserved, and their integration ability did not outperform the digital immigrant teachers. Their reserved perceptions, on one hand, showed that they understood it was a complex process to make technologies facilitate teaching effectively, but on the other hand, revealed that despite the greater comfort with technology as a whole, digital natives still needed training for teaching-specific technologies. Although digital native teachers grew up with digital technology, they mostly used technology for entertainment and communication purposes, and not specifically for teaching and learning purposes, and hence they have no experience of integrating technologies with their work. This reasoning can be further supported by the finding that the digital native teachers were proficient with basic technologies, such as web surfing, communicating online, and word processing, but they reported low proficiency in advanced technologies, especially teaching related technologies such as handling Blackboard, Access, and Whiteboard. This finding paralleled with previous research that digital native teachers have sufficient expertise with generic technologies but are not familiar with teaching-specific technologies (Lei, 2009).
The digital native teachers and digital immigrant teachers did not differ in meaningful technology integration. They both needed to develop a systematic understating of the technology, subject content, pedagogy, and how these aspects worked together (Kajijevich, 2012). As pointed out by Kajijevich (2012), for meaningful technology integration to happen, teachers needed to understand pedagogy, content knowledge, technology skills, and, and intersection of the three abilities as technological pedagogical content knowledge. To help the digital native teachers and the digital immigrant teachers integrate technology into teaching in meaningful ways, technology cannot be taught as a separate and independent domain.

Hence, future PDs should first help both the digital native and the immigrant teachers to realize that integrating technology are far more than simply treating technology as a new way of knowledge presentation, but a fundamentally reform of teaching strategies, and then teach teachers how to connect between technology, content, and pedagogy, rather than teach technology itself. For different subject specifically, PDs would carefully design and show participants good examples of technological pedagogy with the purpose of helping them integrate and apply technology to support their teaching. In addition, digital native teachers could be taught more advanced technology skills while digital immigrant teachers could be taught more technology operational skills.

SHIFTING THE FORMAT OF PROFESSIONAL DEVELOPMENT TO INDIVIDUAL COACHING FROM LECTURING

Due to large population in China, large-size lecturing is a traditional approach for educational activities. It has long been acknowledged in China the large-size lecture focused on knowledge-transmission, minimized interactions between teachers and students, and failed to develop students' hand-on skills and critical thinking ability (Han, 2014). Chinese students are taught to show respect for those elder, and teacher is regarded as the expert whose speech cannot be questioned. In this teaching culture where learners act as knowledge receivers, learners had little chance to practice in class. This culture is contradictory with western culture, where in the western literature, learner-centered strategies and collaborative learning groups are supported in educational activities, and has been repeatedly demonstrated successful (Thota & Negreiros, 2015). Future PDs in China could firstly be shifted from an instructor-centered approach to a learner oriented approach where the students take ownership of their learning. Secondly, future PDs could provide teachers with more individual coaching and sustained support after the program.

IMPLICATIONS FOR OTHER COUNTRIES WITH SIMILAR CULTURE OR PRACTICE

The finding provided important lessons for other developing countries with similar culture or practice with China. The study found that the digital native teachers and digital immigrant teachers have different needs for professional development. The finding is similar to those that concluded from developed country. As educational technology continues to be implemented incrementally in many parts of the developing countries, the countries have finished the technology infrastructure development (power, Internet connectivity and bandwidth), and currently working on the teacher training to support the sustainability of technology implementations. Governments and funding agencies often talk about the need to improve teachers' ability to use technology. For example, Chinese government announced a national act that all teachers before age 40 must participate in the national technology training program every three years. However, developing countries usually provide for a large number of people to receive minimal training with a short period of time due to their shortage of funding or over-sized population. Their focus seems to be on quantity not quality. For example, the most popular technology training in China is one-week lecturing for all age band teachers. Perhaps, when funds are limited, a more effective approach would be to give teachers what specifically they need. The digital native teachers have already been good at technology techniques, so development training programs should save the efforts of technology introduction for technology integration; while the digital immigrant teachers should be taught technology knowledge first before introducing integration to them. Obviously, the needs of the digital native teachers and digital immigrant teachers are different. Hence, one size fit-to-all teacher professional development is not appropriate for developing countries. Otherwise, the program would not be effective but a waste of money.

The dominant training form in developing country is short-period lecturing since it has been considered one of the most economically efficient methods. While

in the developed countries, the popular form is group work or collaboration. Admittedly, developing countries have more practical problems than developed countries, such as more budget dilemmas, shortage of quality teachers, and limited laptops provided. In addition, most developing countries respect power distance which refers to the inequality between bosses and inferiors and the extent to which this is accepted (Hofstede, 1984). In the Chinese culture as well as some other Asian cultures, teachers have been considered as the center of the knowledge and the classroom are structured as one platform in the front and many seats fixed and facing the teachers. In this situation, student seats cannot be moved to form a circle to facilitate discussion or collaboration. However, administrators and educators in developing countries should be aware of lecturing format is not suitable for learning technology integration for teachers. They should think about how to take advantage of local resources and initiate the efforts to make the change, even a very small step at the beginning. In the developing country, the pedagogy should be shifted from a more instructor-centered approach to a learner oriented approach where the students take ownership of their learning. Future PDs could gradually shift the training format into individual coaching and project-based or collaborative project examination. The training programs need to help creating a culture of continuously individualize technology integration support, a community of educators focused on best practices of technology integration as a tool for engaging learners to develop a school's culture of advancing teachers' technology skills.

LIMITATIONS AND SUGGESTIONS FOR FUTURE WORK

It was acknowledged that there were limitations in categorizing digital native teachers and immigrant teachers only based on born year in this study. It was unreasonable to paint a monolithic portrait of the young generation as technologically savvy and technologically enthusiastic, while the older generation as technologically impaired and a technology opponent. Jelfs and Richardson (2013) suggested that stereotyping digital technology use between younger and older learners should be rejected. The large variation of generation called for more studies to research other factors, other than age, to paint the distinctive portraits of digital natives versus digital immigrants.

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NOTE

The authors declare no conflict of interest. The data for this research can be accessed by your request. The research was conducted under the approval of Chinese government. The rights and welfare of human subjects involved in the research are protected during their participation

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APPENDIX

TABLES

Table 1: *Demographic information for digital native and digital immigrant teachers*

	Digital natives N=166	Digital immigrants N=334
Gender (%)		
Male	40.36	65.57
Female	59.64	34.43
Ethnicity (%)		
Han	78.31	83.53
Non-Han（minority）	21.69	16.47
Diploma/Degree (%)		
Associate degree	9.04	15.57
Bachelor degree	85.54	77.54
MS or PhD degree	5.42	3.89
Teaching experience (%)		
5 years and below	38.55	0.30
5-10 years	56.63	2.10
11-20 years	4.82	44.61
21-30 years	0.00	41.62
30 years above	0.00	11.38
Teaching grade (%)		
Primary school	22.89	23.65
Junior higher school	19.88	37.13
High school	57.23	39.22

Table2: *Differences between digital native (NA) (N=166) and digital immigrant (IM) teachers (N=334)*

Constructs & variables	Brief statements of measures	NA (%)	IM (%)	Odds ratio	Wald 95% C.I.
[1] First time access	High school and earlier	92.17	38.32	18.82	[11.06, Inf] ***
	Work	7.83	61.68	0.05	[0.00, 0.09] ***
[1] Time spent on technology	Less than 2 hours	43.98	53.89	0.67	[0.00, 0.93] *
	2 hours and more	56.02	46.11	1.49	[1.07, Inf] *
[2] Perceived ease of use (Alpha=0.71)	Find technology easy to use	68.67	51.50	2.06	[1.46, Inf]***
	Interaction with technology does not require much effort	35.55	26.65	1.52	[1.06, Inf]*
	Easy to satisfy the national standards of educational technology use	59.64	46.71	1.68	[1.21, Inf]**
[2] Perceived usefulness (Alpha=0.82)	Using technology improve my performance	57.23	53.89	1.14	[0.82, Inf]
	Using technology increases my productivity	77.11	81.13	0.78	[0.00, 1.18]
	Using technology enhances my effectiveness	75.30	75.45	0.99	[0.00, 1.46]
[2] Intentions to use (Alpha=0.81)	Plan to use technology in the future	77.03	79.39	0.88	[0.00, 1.32]
	Wish more opportunity to use technology for future teaching	81.08	81.68	0.97	[0.00, 1.50]
[2] Integration technology (Alpha=0.77)	Able to find useful information online to enrich my class	84.94	85.63	0.95	[0.00, 1.53]
	Able to choose appropriate technologies for different teaching purposes	76.51	77.24	0.96	[0.00, 1.43]
[1] Attitude and belief	Like working with technology	75.67	68.32	1.46	[1.01, Inf]*
[1] Professional development	Having received technology professional developments in recent 3 years	66.27	59.58	1.33	[0.94, Inf]+
	Technology trainings were very helpful for teaching	8.70	9.85	0.84	[0.00, 1.51]
	Willing to participate in training for technology skills and integration	96.39	97.29	0.74	[0.00, 2.12]

Note：+$p < 0.1$,* $p < 0.05$，** $p < 0.01$，*** $p < 0.001$; [1] Observed variable; [2] Latent construct.

% was calculated by sum of the numbers of participants who rated strongly agree and agree, over the total.

Table 3: *Odds ratio test on different purposes of digital technology use by digital native (N=166) and digital immigrant teachers (N=334)*

Purposes of technology use	Digital native (%)	Digital immigrant (%)	Odds ratio	Wald 95% C.I.
Learning for knowledge	71.08	79.64	0.63	[0.00, 92]*
Creative work	30.12	40.42	0.63	[0.00, 0.90]*
Email for work	31.33	43.11	0.60	[0.00, 0.85]**
Class preparation	88.55	76.65	2.35	[1.46, Inf]***
Social networking	65.66	48.80	2.00	[1.42, Inf]***
Shopping	33.13	21.86	1.77	[1.22, Inf]**
Entertainments	55.42	33.53	2.46	[1.76, Inf]***
News	72.89	70.66	1.12	[0.77, Inf]

Note：* $p < 0.05$，** $p < 0.01$，*** $p < 0.001$

Table 4: *Comparisons of digital native (N=166) and digital immigrant teachers' (N=334) technology proficiencies*

Dependent variables	Grouping variables	Mean	SD	*t*	Effect size *d*
Basic proficiency	Natives	3.43	0.58	7.99***	0.71
	Immigrants	2.90	0.75		
Lower proficiency	Natives	3.02	0.67	8.55***	0.76
	Immigrants	2.41	0.78		
Upper proficiency	Natives	2.49	0.74	8.30***	0.75
	Immigrants	1.91	0.71		
Advanced proficiency	Natives	1.65	0.64	4.59***	0.44
	Immigrants	1.38	0.58		
Overall	Natives	2.65	0.55	8.64***	0.78
	Immigrants	2.15	0.62		

Note：* $p < 0.05$，** $p < 0.01$，*** $p < 0.001$

Table 5: Odds ratio test on PD forms by groups

PD forms	NA(n=110) (%)	IM (n=199) (%)	Odds ratio for teacher groups [Wald 95% C.I.]	Overall (%)	Odds ratio for training types [Wald 95% C.I.]
Lecturing (L)	89.09	87.44	1.18 [0.70, Inf]	87.99	
Distance online training (D)	55.45	48.74	1.30 [0.94, Inf] +	50.97	D/L:7.20 [4.07, Inf]***
Project based training (P)	19.09	12.06	1.75 [1.11, Inf]*	14.40	P/L: 42.80[23.00, Inf]*** P/D: 6.04 [3.71, Inf]***

Note: +$p < 0.1$, *$p < 0.05$