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TPACK in Special Education Schools for SVI: A Comparative Study between Taiwanese and Chinese In-service Teachers

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ABSTRACT

While Technological, Pedagogical, and Content Knowledge (TPACK) has been studied in many domains, its application in special education remains limited. This study examined the TPACK of in-service teachers at special education schools for students with visual impairments (SVI, $N = 415$) and further compared the TPACK of Taiwanese and Chinese teachers. Based on both Taiwanese and Chinese samples, we revised and validated a TPACK survey for teachers in special education schools for SVI. Results showed that special education schools for SVI teachers knew content knowledge and teaching strategies better, however, they were less knowledgeable about technological tool applications. Furthermore, Chinese teachers scored higher than Taiwanese teachers in

In this article



...edge (TCK/TPACK) and content knowledge and teaching
...ns were put forward regarding school leadership. peer

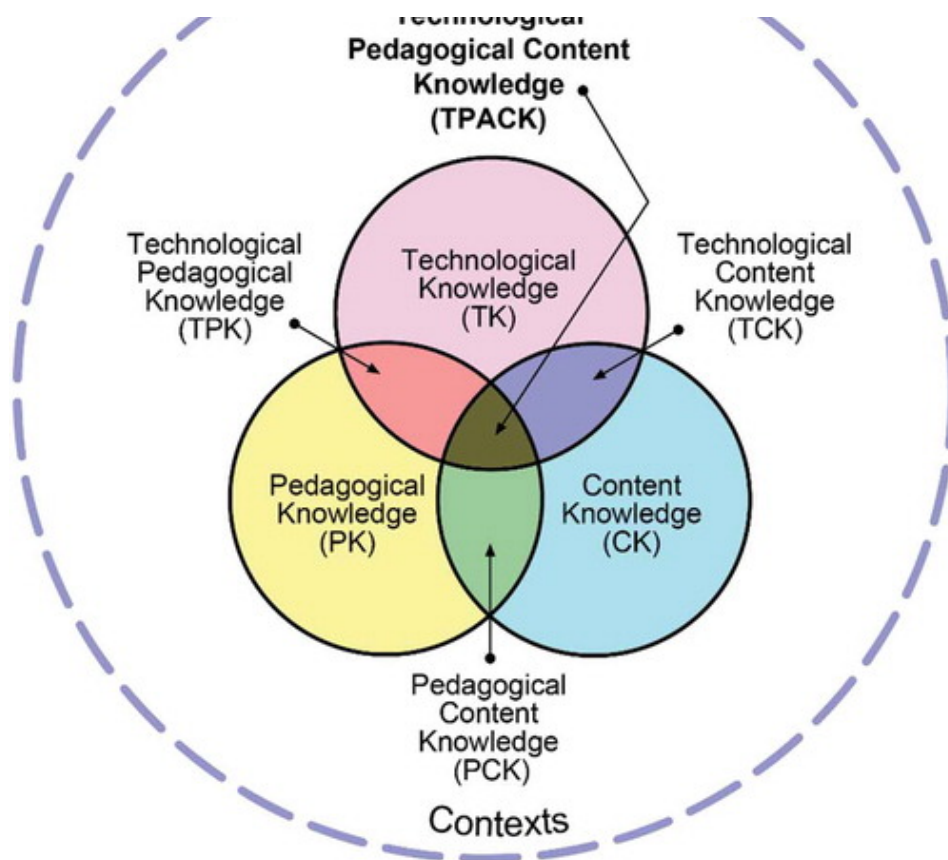
sharing, and interactions between Taiwanese and Chinese special education in-service teachers.

KEYWORDS: [Comparative study](#), [in-service teachers](#), [special education](#), [students with visual impairments](#), [TPACK](#)

Introduction

In the information era, many countries have been actively implementing technologies into special education, including learning and instruction for students with visual impairments (Zhou et al., [2012](#)). In Taiwan, SVI teachers of special education schools teach how to use screen readers like NonVisual Desktop Access (NVDA), Gmouse and Jaws. In China, teachers at special education schools for SVI use screen readers including Yong-de and Zheng-du developed by local companies (Xu, Kent, Ellis, & Zhang, [2016](#)). These screen readers assist students to read Chinese characters on web pages and also Word documents. In addition to adopting assistive tools, in China major special education schools for SVI shared their teaching experience with a school in Philadelphia through the Internet. Similarly in Taiwan, the Taipei Municipal Special Education School for SVI launched an online programme with Hiroshima Special Education School for SVI in order to foster multi-cultural experience of both Taiwanese and Japanese students. Such technology implementations help break through the limitations of time, space, and the students; the technologies also help teachers and students acquire different sorts of information and enhance mutual learning through online interactions.

Figure 1. The TPACK model (Koehler & Mishra, [2009](#), p. 63).



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Technology-infused teaching with appropriate strategies bears great potential to improve the ability and modality of the students. In one instance, Stangl, Kim, and Yeh (2014) developed 3D-printed picture books for students with visual impairments, so that they can use their sense of touch to recognise the 3D tactile aids. In turn, the 3D books facilitated their memory processing and learning. Technology also provides opportunities for teachers in special education school for SVI to develop diversified teaching and instructional design skills. For instance, teachers can use the voice feedback function of screen readers to facilitate students with visual impairments' online information search and documents creation with word processing software. As Nemeth Code (a special type of braille used for maths and science notations) is important for students with visual impairments to learn mathematics in China and Taiwan, teachers can design web-based tutorials to reinforce their capabilities of using Nemeth Code. Evidenced by Herzberg, Rosenblum, and Robbins (2016), such online tutorials can improve students learning of tactile graphics, formatting, and the overall knowledge of Nemeth Code.

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- ▲ supported the benefits of general and assistive technologies
- with visual impairments in different subject areas. Zhang

(2015) found that the use of multimedia and the Internet (coupled with the aforementioned screen readers) in geological classes made it easier for students to access online geology journals, magazines, and videos to broaden knowledge horizons. In algebra classes, students with visual impairments were found to better understand algebraic expressions in the format of digital text, which was supported by the ReadHear eText programme (Bouck, Joshi, Meyer, & Schleppenbach, 2013). Technology was also used to support music learning. For example, the Miami Lighthouse Better Chance Music Production Programme, which features 26 lessons in braille music notation, was designed to instruct students with visual impairments around the world in music production and composition techniques through MIDI (Musical Instrument Digital Interface) software and the Job Access with Speech (JAWS) screen-reading software (Jacko, Choi, Carballo, Charlson, & Moore, 2015). Given the permeation and positive impact of technology in special education, teachers specialising in visual impairment are facing more expectations to develop knowledge and skills to integrate technologies into their classrooms, so that students' motivation and learning, and teachers' professional development can be leveraged.

A framework that delineates teachers' knowledge for technology implementation is *Technological, Pedagogical, and Content Knowledge (TPACK)*, which 'attempts to capture some of the essential qualities of teacher knowledge required for technology integration in teaching, while addressing the complex, multifaceted, and situated nature of this knowledge' (Mishra & Koehler, 2006, p. 1017). TPACK has been applied to many subject areas such as mathematics (Stoilescu, 2015), science (Chen, Jang, & Chen, 2015), and language teaching (Wong, Chai, Zhang, & King, 2015). However, TPACK is still a novel idea in the field of special education, and for teachers of students with visual impairments in Taiwan and China. In the following section, we will briefly introduce the concept of TPACK, followed by a rationale of studying TPACK in special education for SVI.

Technological, Pedagogical, and Content Knowledge (TPACK)

TPACK is an extension of Shulman's (1986, 1987) *Pedagogical Content Knowledge* (PCK). According to Shulman, teachers are not able to reach their pedagogical goals simply by

repertoire (i.e., PCK), through which they are more able to help students overcome their learning difficulties. With the vast development and immersion of ICT, Koehler and Mishra (2005) further added Technological Knowledge (TK) into Shulman's PCK model. They argued that it is essential for teachers to amalgamate TK, PK, and CK to achieve effective instruction in the twenty-first century. Voogt, Fisser, Roblin, Tondeur, and van Braak (2013) indicated that researchers can employ TPACK as a measuring tool to examine teachers' knowledge structure and development. TPACK can also serve as a conceptual guideline for teachers' self-reflection on their practices of technology integration (Chen & Jang, 2014).

There are 7 categories of knowledge in the design of TPACK (Koehler & Mishra, 2009, see Figure 1). The three pillars of teacher knowledge are TK, PK, and CK. The overlap between the three types of knowledge further creates four types of knowledge, namely PCK, TCK, TPK, and TPACK. Cox and Graham (2009) explained that these categories were in line with the technology or pedagogical approaches used in a given subject field and the technology used in general pedagogical content. Mishra and Koehler (2006) stated that the overlapping areas of TPK, TCK, and PCK were the stepping stone of the development of TPACK.

Researchers have been exploring teachers' TPACK and its related factors. Banas (2010) looked at 225 teachers' attitudes toward technology. It was found that the teachers' TPACK improved in response to more complicated learning with technology. Harris and Hofer (2011) discovered that when designing ICT-integrated courses, the content of the course would influence instructional decisions made by teachers. Koh and Chai (2014) reviewed 354 Singaporean in-service teachers and their constructivist TPACK. They discovered a positive relationship between teachers' understanding of TPK, TK, and TCK, and their knowledge of constructivist TPACK. Based on 3 years of observation, Niess et al. (2009) found that in-service teachers' TPACK development can be sorted into five stages of ICT incorporation, of which the final stage was exploration of needs for curricula.

To accelerate teachers' TPACK development, *learning by design* (Koehler & Mishra, 2005), *peer coaching* (Jang & Chen, 2010), modelling (Chai, Koh, & Tsai, 2011), and *technology mapping* (Angeli & Valanides, 2009) have been helpful. The last refers to the process of

connections between technology-related skills and the subject content to be taught, they presented their TCK obviously in their course design. More importantly, in-service teachers could also strengthen their perceptions of other aspects of knowledge in the TPACK framework by watching ICT-integrated examples that were demonstrated by experts in a given subject (Liu, Zhang, & Wang, 2015). In a nutshell, studies have highlighted a need to keep elaborating strategies to help teachers develop their TPACK. There is also a need to look deeper into factors that influence teachers' TPACK development.

Gaps, Purpose, and Questions

A review of literature showed that, while technology integration has been promoted in special education and TPACK has been well accepted as a conceptual framework for teachers' knowledge development in general education, to date the application of TPACK in special education is still in its inception (Anderson, Griffith, & Crawford, 2017). Among the few articles retrievable, Tournaki and Lyublinskaya (2014) examined the TPACK development of pre-service teachers who teach mathematics and science for students with mild learning and behaviour disabilities. Through integrating instructional technologies and teaching strategies, the pre-service teachers significantly improved their TCK, TPK, and TPACK. More recently, Anderson et al. (2017) studied 14 pre-service teachers' experiences with integrating technology into lessons with children who had mild learning disabilities. Qualitative lesson plans, journals, and interview data showed that the pre-service teachers could identify technology-related instructional decisions and exhibited their knowledge growth in TPACK dimensions.

The above studies provide support of the applicability of TPACK in Special Education; however, their participants were exclusively pre-service teachers, and the area of study was mainly learning disabilities. On the other hand, TPACK studies on Special Education for SVI are non-existent, and special education *in-service* teachers' knowledge profiles have yet to be examined. The purpose of this study was to explore the TPACK of in-service teachers at special education schools for SVI in Taiwan and China. As Taiwan and China can be regarded as two representative entities in the Chinese Community, plus

teachers at special education schools between Taiwan and China. Due to the paucity of related measurements, in this study, we will revise and revalidate a TPACK survey for the teachers. Such scale validation may not only improve the rigour of this study, but it will also contribute to the TPACK knowledge base and stimulate future studies. Two main research questions guide the present study:

RQ1: What are the TPACK profiles of teachers in special education schools for SVI?

RQ2: What are the TPACK differences between China and Taiwan teachers in special education schools for SVI?

Methodology

Participants

A total of 415 special education schools for SVI in-service teachers participated in this study. One hundred and thirty-four (134) of them came from the nine major schools for SVI of Taiwan, and the remaining 281 teachers were recruited from the 11 major cities of China wherein the major schools for SVI were located. Regarding their demographic composition, overall 71.53% were female, and 44.10% of them aged between 31 and 40. Interestingly, only 27.23% of the teachers had been using e-learning platforms for course preparation, teaching, and class management.

Instrument: The Revised TPACK Survey

For measuring Taiwanese and Chinese special education schools for SVI in-service teachers' knowledge for teaching, we adopted the 42-item TPACK survey from the Chai et al.'s (2011) study. The main reason is that the survey is among the very few TPACK instruments that successfully validated all the seven constructs of TPACK through factor analysis. In addition to general technology knowledge, they also added TK items that focused on specific web-based technologies, for example, 'I am able to use online social media (e.g., blogs, wikis, Facebook) to meet the trend of technology development'.

were attending a 12-week compulsory course on the integration of ICT for teaching and learning. To begin with, we slightly modified the item narratives to make it more context or subject-specific. Subsequently, five Taiwanese and Chinese scholars specialising in Educational Technologies and Visual Impairments helped review the items to ensure that the translated items were adequately and clearly stated. Based on expert feedback, the technologies/examples listed in the items were differentiated for Chinese and Taiwanese in-service teachers. For example, in the Taiwanese version item TK8 was described as 'I am able to use online social media (e.g., blogs, wikis, and Facebook)'. However, in the Chinese version 'Facebook' had been changed to 'Weibo' because Facebook was not commonly used in China, and Weibo could be treated as an alternative example for Chinese teachers.

Thirdly, we proceeded with factor analysis to explore the dimensions of the TPACK scale as perceived by current Chinese and Taiwanese special education schools for SVI teachers. Before factor analysis, one item was deleted because its correlation with the total scale was low. In addition, Bartlett sphericity test and the KMO index were calculated via SPSS 22.0 to determine the suitability of factor analysis. The former was significant at .001 level (Chi-square = 16,648.818, df = 820) and the latter was .951. Both results provided evidence that the data were appropriate for factor analysis.

Six factors (see [Table 1](#)) came out as a consequence of the exploratory factor analysis (with direct oblimin rotation), which explained 74.676% of the total variance. The first factor contained all the five TPCK items and three of the original TCK items. As such, we named the dimension as 'TCK/TPACK'. Factor 2 included all the original PCK items so that we kept the original factor name 'PCK'. Factor 3 consisted of CK and PK items which described the knowledge of the subject matters and strategies to deliver instruction. As such, we renamed this combined factor as 'Content Knowledge and Strategies' (CKS). All the original TK items and four of the TPK items were grouped into the fourth dimension. As these items described teachers' self-reporting of their general technology ability, as well as what they know to apply technologies to help students with visual impairments, we kept the original name as 'Technology Knowledge (TK)'.

TABLE 1. THE STRUCTURAL MATRIX OF THE TPACK SCALE (DIRECT Oblimin Rotation).



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The fifth dimension contained TPK and TCK items that described teachers' ability to apply assistive technology and specific tools (software and platforms) for teaching students with visual impairments (e.g., 'I am able to use specially designed software, for example, screen reader, for my students with visual impairments' and 'I can choose appropriate teaching software for my students with visual impairments according to the needs of them.'). Therefore, the factor was named as 'Tool Application (TA)'. Lastly, the two *collaborative learning* (CL) items mentioned earlier in this section – 'PK5: I am able to plan group activities for my students' and 'PK6: I am able to guide my students to discuss effectively during group work' – loaded together to describe teachers' ability to design and facilitate collaborative learning. As subscales with less than three items may experience issues such as low reliability and lack of representativeness (Tabachnick & Fidell, 2007), we decided to eliminate the 2-item factor. The remaining 39 items went through factor analysis again and we found the item grouping remained unchanged. The new five-factor solution explained 72.807% of the total variance.

Regarding reliability, Cronbach alphas were computed to assess the internal consistency of the scale items. As shown in Table 2, the alphas of the total scale and the five subscales ranged from .861 to .968, indicating very high reliability. Based on the EFA and reliability data, plus content validation through the previously described expert review, we deemed our TPACK instrument a valid and reliable tool to assess Taiwanese and Chinese special education schools for SVI teachers' TPACK. The full items of the revised TPACK scale are listed in Appendix A.

Table 2. The Reliability of the TPACK Scale.



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Data Collection and Analysis

In this article



ed out through both paper-based and electronic formats. The
erv maior special education school for SVI in Taiwan and

China. Based on proportional sampling, 320 copies were sent to China, and we have received 281 valid responses (the valid response rate was 87.81%). On the other hand, 158 copies were sent to special education schools for SVI in Taiwan, and we have received 134 valid responses, making the valid response rate 84.81%. As with data analysis, descriptive analysis (using SPSS 22.0) was applied to answer Research Question 1: 'What are the TPACK profiles of teachers in special education schools for SVI?' A series of one-way MANOVA was conducted with gender, age, and e-learning platform experience as independent variables and with TPACK dimensions as dependent variables. Research Question 2: 'What are the TPACK differences between China and Taiwan teachers in special education schools for SVI?' was also analysed through one-way MANOVA with region as independent variable and with TPACK dimensions as dependent variables. Such comparisons were designed to display patterns of group differences that may shed light on the facilitation of technology integration in the special education schools for SVI.

Results

The Profiles of Special Education Schools for SVI In-service Teachers' TPACK

Table 3 presents the knowledge profiles of the special education schools for SVI in-service teachers. Overall, the scale average score was 3.576 ($SD = .556$), and all the subscale scores were higher than 3.0, the midpoint of the 5-point scale. The above results indicate that the special education schools for SVI in-service teachers had good knowledge for teaching. Among the subscales, teachers scored highest on CKS ($M = 3.819$, $SD = .604$) and lowest on Tool Application ($M = 3.271$, $SD = .604$). Paired sample t-test results further showed that special education schools for SVI in-service teachers' knowledge, from highest to lowest, were:

Table 3. Participants' Scores on the TPACK Dimensions.



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TK, PCK, TCK/TPACK

TA

In addition to in-service teachers' TPACK profiles, we further explored group differences based on demographic variables including age, gender, and e-learning experience of the special education schools for SVI in-service teachers (see Table 4 for a summary of MANOVA results). For gender, the multivariate result was significant, Pillai's Trace = .038, $F(6,369) = 2.462, p = .000$, indicating a difference in the level of TPACK between male and female teachers. The univariate F tests showed that males scored greater than females in terms of TK ($F(1, 374) = 8.073, p = .005, \eta^2 = .021$), TA ($F(1, 374) = 5.499, p = .020, \eta^2 = .014$), and the total TPACK scale score ($F(1, 374) = 3.861, p = .050, \eta^2 = .010$).

Table 4. Summary of MANOVAs on TPACK Scores with Gender, Age, and E-Learning Platform Experience.



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Regarding age, the multivariate result was significant, Pillai's Trace = .0165, $F(18, 1200) = 3.882, p = .000$, indicating a difference in the level of TPACK among the four age groups. The univariate F tests showed that there was a significant difference among the four age groups for TCK/TPACK ($F(3, 407) = 3.680, p = .012, \eta^2 = .027$), CKS ($F(3, 407) = 3.473, p = .016, \eta^2 = .025$), TK ($F(3, 407) = 7.940, p = .000, \eta^2 = .056$) and TA ($F(3, 407) = 3.497, p = .0160, \eta^2 = .025$). Post hoc comparisons (with the Scheffe' method) revealed that, in-service teachers aged between 20–30 and 31–40 possessed higher TK than those aged between 41 and 50; also those aged between 31 and 40 had higher TCK/TPACK than the 41–50 age group. On the other hand, participants who were older than 51 possessed greater CKS than those aged between 21–30 and 42–50.

As with e-learning experience, the multivariate result was significant, Pillai's Trace = .094, $F(6, 389) = 6.711, p = .000$, indicating a difference in the level of TPACK between users and non-users of e-learning platforms. The univariate F tests showed that, those with experience using e-learning platforms possessed greater TCK/TPACK ($F(1, 394) = 22.941,$



score ($F(1, 394) = 26.826, p = .000, \eta^2 = .064$) than those without e-learning experience. It appears that practical experience of using technologies for instruction has great potential to influence in-service teachers' TPACK. A summary of the above MANOVA results is presented in [Table 4](#).

Comparisons between Taiwanese and Chinese Special Education Schools for SVI Teachers' TPACK

[Table 5](#) presents a summary of MANOVA that compared Taiwanese and Chinese special education schools for SVI in-service teachers' TPACK. Overall, the multivariate result was significant, Pillai's Trace = .041, $F(6, 401) = 2.881, p = .041$, indicating a difference in the level of TPACK between Taiwanese and Chinese teachers. The univariate F tests further showed that there was a significant difference between Taiwanese and Chinese teachers for TCK/TPACK, $F(1, 406) = 5.367, p = .021, \eta^2 = .013$ and CKS, $F(1, 406) = 3.891, p = .049, \eta^2 = .009$. However, no significant differences were found in TK, TA, and PCK dimensions.

Table 5. MANOVA on the TPACK Scores between Taiwanese and Chinese Teachers.



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Discussion

Validation of the TPACK Scale for Special Education Teachers for SVI

In this study, we revised and validated a TPACK scale for special education school for SVI teachers. Deviating from Chai et al.'s (2011) original seven constructs, we came up with a five-factor solution which includes TCK/TPACK, PCK, CKS (i.e., CK+PK), TK and TA dimensions. More specifically, in this study PK and CK were conglomerated to yield the CKS dimension, TPACK and TCK items loaded together, whereas TA stood out as a significant factor in this study. We suppose that CK and PK loaded together because in Taiwan and China teacher education programmes usually treat content and methods

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like 'Teaching Materials and Methods in Special Education' to
ers' basic knowledge and skills. Under this arrangement our

participants might have formed a mindset that link CK and PK together. Moreover, TPACK and TCK items loaded together, and we thought that as the notion of TPACK is still a novice idea in Special Education, the participants might not be sensitive enough to differentiate TPACK with adopting technologies to teach course content, which falls into the realm of TCK. Our finding also echoes Koh and Chai (2014) study wherein teachers' TCK had the most significant direct path to TPACK, meaning that TCK was perceived to exert a larger positive influence on the practising teachers' TPACK formation in Singapore.

It is notable that tool application (TA) stood out as a distinct factor, meaning that the teachers were aware of the utility of assistive technological tools to help students with visual impairment. It is recognised that at a time where there has been an explosion of information, the relevance of assistive technology as a critical skill for all students with visual impairments cannot be underestimated (Zhou et al., 2012). This is especially the case as in recent years the Taiwan and Chinese governments have been propagating assistive technological tools to help students' classroom learning. In addition to helping learning of students with visual impairments at schools, they have also been equipping students with visual impairments with technological skills to meet the needs of the job market when they graduate. Lastly, although we deleted the sixth factor (CL) because it only contained two items, still attention needs to be given as to why it is relevant. Here we suggest that teachers in this field can help students with visual impairments learn content knowledge or braille instructions through collaborative learning and/or online interactions to enhance mutual support among students.

Special Education for SVI Teachers' TPACK Profiles

In this study, special education for SVI teachers scored highest on CKS ($M = 3.819$) but lowest on TA ($M = 3.271$), which bears semblance to our previous study on Taiwanese secondary school in-service teachers (Chen & Jang, 2019, 2014). The high CKS score reflects that the participants were confident with their expertise in the subject area and strategies to teach their students with visual impairments; the high CKS may also be ascribed to in-service teachers' hands-on experience over the years to sharpen their content knowledge and teaching strategies (Lederman, 1999). On the other hand, the much lower score of tool application (TA) may reflect the point that Taiwanese and

service teachers lack sufficient access to learn and use the assistive technologies at school. Hence, obtaining assistive technology devices for trial use is one approach that could alleviate uncertainty and enhance confidence among teachers about such technologies (Wong & Law, 2016). What is more, it is advised that professional development programmes help the teachers to buy in the value of technological tools for instruction, and gradually familiarise themselves to integrate these technologies into their classroom routines.

Our subsequent difference tests showed that special education for SVI teachers' TPACK differs in gender, age, and e-learning platform experience. In terms of gender, male teachers scored significantly higher than females in technology knowledge (TK) and tool application (TA) dimensions, which is consistent with many past studies. For instance, in the Huang and Chiang's (2016) study male teachers surpassed their female counterparts in most technology-related knowledge (TK, TCK, and TPACK), and according to the authors, such gender differences could be attributed to the observation that males have more passion for and exposure to computing and the Internet. In turn, the male teachers may have much more hands-on experience and knowledge about technology. Based on the result of the present study, future steps can be taken to help female teachers overcome possible barriers and strengthen their knowledge and skills of general/assistive technologies.

Regarding age, overall senior teachers had a better hold of the subject matter and strategies to guide their students as compared to younger teachers in this field. On the other hand, younger teachers performed better than senior teachers in learning, applying, enhancing, and integrating technologies for teaching (i.e., TK, TA, and TCK/TPACK). Zhou, Smith, Parker, and Griffin-Shirley (2011) argued that the disproportionate relationship between the participants' age and their level of confidence in their capability to teach and use assistive technologies might be that the younger participants grew up using technology in their day-to-day lives while the older teachers learned how to use technology as their professional and personal circumstances required. In addition, Huang and Chiang (2016) noted that younger teachers might learn knowledge of technology more quickly and be more open-minded to new ideas, and that older people's abilities to enhance their technology knowledge and to innovate were weaker as compared to their younger counterparts.

of the independent sample t-tests all reached .001 significance level, and the effect sizes were comparatively larger in this study. This result echoes Jang & Tsai (2012) study wherein Taiwanese elementary mathematics and science teachers who used interactive whiteboards (IWBs) possessed greater TPACK than those who did not use IWBs. It becomes clearer that using technologies or not makes a difference, as practical experience with e-learning tools can provide rich opportunities for teachers to explore the affordances of the technologies, gain confidence to use the tools, ruminate how to integrate such tools with course content and instructional strategies in their classroom context, and revise instruction based on reflections of the effectiveness of teaching and learning. As such, encouraging special education for SVI in-service teachers to adopt e-learning technologies would be both a starting point and a pathway to promote their TPACK development (Niess et al., 2009).

Comparison between Chinese and Taiwanese Teachers' TPACK

In this study, we compared Taiwanese and Chinese special education schools for SVI teachers' TPACK. Chinese teachers outperformed Taiwanese teachers in terms of CKS and TCK/TPACK. It shows that Chinese teachers had a better grip of the basic knowledge and skills for teaching, and they self-reported higher abilities to apply and integrate technologies in their classrooms. To date in China Special Education Schools for SVI often hold inter-school competitions of integrating technologies into teaching, while Taiwan had not seen similar events before. The above evidence may help explain why Chinese teachers reported greater scores on TCK/TPACK.

Back to the CKS dimension, it is very interesting that the most significant item was '(CKS1) I am confident about teaching the subject matter', for which Chinese teachers outperformed Taiwanese counterparts; however, Taiwanese teachers scored greater than Chinese teachers in '(CKS4): I can think about the content of my teaching subject like a subject matter expert'. Is it possible that Chinese teachers are more confident with their teaching, so that such confidence may to some extent carry over to their overall TPACK scores? Is there cultural difference between Chinese and Taiwanese teachers to interpret the term 'expert' in CKS4, so that the item becomes the only one that Taiwanese teachers scored higher than Chinese teachers? These are followed-up

Limitations, Suggestions, and Future Directions

Despite our efforts to increase rigour, this study has its limitations. Foremost is that the participants' TPACK was assessed only by a self-report TPACK questionnaire, which runs the risk that respondents' general self-confidence and social desirability bias may to some extent interplay with the study results. Future work can further incorporate more objective measures such as on-site observations, peer assessments, and one-on-one interviews to understand teachers' conceptions, actions, and reflections on technology integration and their knowledge for instruction. Furthermore, as previously mentioned, during our scale validation the collaborative learning (CL) dimension was removed because it only contained two items. Elimination of the dimension may somewhat confine the scope of special education for SVI teachers' TPACK. Future studies may explore the role of collaborative learning and revise the scale items where necessary.

Another limitation is that although statistically significant differences were found between gender, age, e-learning platform usage, and region (i.e., Taiwan and China), overall the effect sizes were small (Cohen, 1988), limiting practical significance of data. Therefore, readers should be cautious not to over-interpret the statistical results. Instead, we hope this exploratory study could help raise our awareness about potential demographic influences on teachers' TPACK. On the other hand, more research efforts can be dedicated to investigating teachers' voices and experiences across gender, age, e-Learning platform usage, and region. Also, it would be a worthwhile endeavour to explore factors that may potentially mediate or moderate the influences of demographics on teachers' TPACK.

Based on the results of this study, here we propose several practical suggestions.

1. Enrich technology learning and application opportunities for the in-service teachers, especially using assistive technologies to teach students with visual impairments. Leaders at special education schools for SVI in Taiwan and China can proactively provide a wide variety of professional development activities, such as workshops and seminars to leverage teachers' abilities to master technological software and tools. As Zhou et al.

leaders of the special education school for SVI are advised to offer teachers opportunities to incorporate digital learning into their teaching. Zhou et al. (2012) further noted that there were neither textbooks nor curricula on assistive technology for in-service teachers to use. As such, leaders can invite technology and subject matter experts, as well as experienced instructors to work together on designing textbooks and curricula that incorporate general and assistive technologies for effective instruction.

2. Foster professional cooperative teams between younger and senior teachers. This study found that younger teachers were more knowledgeable about technology whereas senior teachers were more versed in content knowledge and instructional strategies. It would be beneficial that younger and senior teachers work together in formal teams or informal gatherings on course planning, resource demonstration, and knowledge/experience sharing. More specifically, senior teachers can offer pedagogical strategies and experience of teaching content knowledge to students with visual impairments. On the other hand, young teachers can demonstrate how they learned and used technology, and how they exert the potential of technology to facilitate cooperation and mutual support among students with visual impairments.

3. Reinforce interactions and collaborations between Taiwanese and Chinese teachers. This study found that the Chinese teachers performed better in integrating digital learning into courses than Taiwanese teachers. Ideally, with the same language and shared background in Special Education, Chinese and Taiwanese teachers can have more interactions with each other and share perspectives/practical experiences of learning and applying digital technologies in their course design and instruction. Through such sharing, the teachers across the Strait can strengthen their ability and confidence of technology integration, in turn consolidating their TPACK. Teachers in both sides can further work together to design activities that enable Taiwanese and Chinese students to make friends and learn collaboratively through the aid of web-based technologies such as Skype, Lino, and Moodle. Such initiatives would provide great opportunities to enhance students' mutual understanding, stimulate high-order thinking, and broaden their cross-cultural perspectives (Deng, Chen, & Li, 2017).

4. Reduce possible barriers of technology integration. Before launching professional development curricula, leaders are advised to closely investigate issues such as why it

Furthermore, to address the lack of training in assistive technology in current professional development programmes (Zhou et al., 2011), leaders of special education school for SVI can hold inter-school competitions on digital curriculum design and technology integration. With such initiatives, the teacher's ability to utilise technology will be strengthened, and more opportunities will be offered to the teachers to observe how other teachers design and facilitate technology-infused classes. In short, leaders in special education should put forward countermeasures to address the difficulties in integrating digital learning into teaching and boost teachers' willingness and confidence of technology integration.

This study is unique in that to our knowledge, this is one of the earliest studies that examine the TPACK of special education in-service teachers for SVI. Especially we have surveyed all of the major special education schools for SVI in Taiwan and China, therefore the data should be representative to portray the status quo of special education for SVI teachers' TPACK in the Chinese Community. In addition, we have revised and validated a TPACK scale for special education for SVI in-service teachers, which is also seminal in the literature. The scale will be helpful to promote research in this area; also it can be used for teachers' self-evaluation of their knowledge for technology integration. Although the comparison results between Chinese and Taiwanese teachers' TPACK may not be sufficient to draw solid conclusions due to the nature of the survey instrument, still it is helpful to raise our awareness about possible similarities and differences between the two sides. Hopefully, this study will stimulate more in-depth studies, as well as promoting interactions and collaborations of teachers and students across the Strait. We sincerely hope that more research efforts will be dedicated to investigating TPACK in Special Education, and more strategies will be generated to promote special education teachers' TPACK, in turn illuminating students' better future in the job market.

Disclosure statement

No potential conflict of interest was reported by the authors.



1. Anderson, S., Griffith, R., & Crawford, L. (2017). TPACK in special education: Preservice teacher decision making while integrating iPads into instruction. *Contemporary Issues in Technology and Teacher Education*, 17(1), 97–127. [\[Google Scholar\]](#) [Find it@NCCU](#)

2. Angeli, C., & Valanides, N. (2009). Epistemological and methodological issues for the conceptualization, development, and assessment of ICT-TPCK: Advances in technological pedagogical content knowledge (TPCK). *Computers & Education*, 52, 154–168. [\[Crossref\]](#), [\[Web of Science ®\]](#), [\[Google Scholar\]](#) [Find it@NCCU](#)

3. Banas, J. R. (2010). Teachers' attitudes toward technology: Considerations for designing pre-service and practicing teacher instruction. *Community & Junior College Libraries*, 16(2), 114–127. [\[Taylor & Francis Online\]](#), [\[Google Scholar\]](#) [Find it@NCCU](#)

4. Bouck, E. C., Joshi, G. S., Meyer, N., & Schleppenbach, D. (2013). Accessing algebra via MathSpeak: Understanding the potentials and pitfalls for students with visual impairments. *Journal of Special Education Technology*, 28(1), 49–63. [\[Crossref\]](#), [\[Google Scholar\]](#) [Find it@NCCU](#)

5. Chai, C. S., Koh, J. H. L., & Tsai, C. C. (2011). Exploring the factor structure of the constructs of Technological, Pedagogical, Content Knowledge (TPACK). *Asia-Pacific Education Researcher*, 20(3), 595–603. [\[Web of Science ®\]](#), [\[Google Scholar\]](#) [Find it@NCCU](#)

6. Chen, Y. H., & Jang, S. J. (2014). Interrelationship between stages of concern and technological, pedagogical, and content knowledge: a study on taiwanese senior high school in-service teachers. *Computers in Human Behavior*, 32, 79–91. [\[Crossref\]](#), [\[Web of Science ®\]](#), [\[Google Scholar\]](#) [Find it@NCCU](#)

7. Chen, Y. H., & Jang, S. J. (2019). Exploring the relationship between self-regulated learning and TPACK of taiwanese secondary in-service teachers. *Journal of Educational Computing Research*, 57(4), 978–1002. [\[Crossref\]](#), [\[Web of Science ®\]](#), [\[Google Scholar\]](#) [Find it@NCCU](#)

31(4), 330–344. [Crossref], [Web of Science ®], [Google Scholar] [Find it@NCCU](#)

9. Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). New York: Academic Press. [Google Scholar] [Find it@NCCU](#)
0. Cox, S., & Graham, C. R. (2009). Diagramming TPACK in practice: Using an elaborated model of the TPACK framework to analyze and depict teacher knowledge. *Tech Trends*, 53(5), 60–69. [Crossref], [Google Scholar] [Find it@NCCU](#)
1. Deng, L., Chen, Y. H., & Li, S. C. (2017). Supporting cross-cultural online discussion with formal and informal platforms: a case between hong kong and taiwan. *Research and Practice in Technology Enhanced Learning (Online)*, 12(1), 5. [Crossref], [PubMed], [Google Scholar] [Find it@NCCU](#)
2. Harris, J. B., & Hofer, M. J. (2011). Technological pedagogical content knowledge (TPACK) in action: A descriptive study of secondary teachers' curriculum-based, technology related instructional planning. *Journal of Research on Technology in Education*, 43(3), 211–229. [Taylor & Francis Online], [Google Scholar] [Find it@NCCU](#)
3. Herzberg, T. S., Rosenblum, L. P., & Robbins, M. E. (2016). Results of an online refresher course to build braille transcription skills in professionals. *Journal of Visual Impairment & Blindness*, 110(4), 269–273. [Crossref], [Web of Science ®], [Google Scholar] [Find it@NCCU](#)
4. Huang, K. Y., & Chiang, F. K. (2016). A quantitative survey of TPACK in special education schools for visually impaired children in China. Unpublished manuscript, Department of Special Education, National Tsing Hua University, Taiwan. [Google Scholar] [Find it@NCCU](#)
5. Jacko, V., Choi, J. H., Carballo, A., Carlson, B., & Moore, J. E. (2015). A new synthesis of sound and tactile music code instruction in a pilot online braille music curriculum. *Journal of Visual Impairment & Blindness*, 109(2), 153–157. [Crossref], [Web of Science ®], [Google Scholar] [Find it@NCCU](#)

7. Jang, S. J., & Tsai, M. F. (2012). Exploring the TPACK of Taiwanese elementary mathematics and science teachers with respect to use of interactive whiteboards. *Computers & Education*, 59(2), 327–338. [Crossref], [Web of Science ®], [Google Scholar] [Find it@NCCU](#)
8. Koehler, M., & Mishra, P. (2009). What is Technological Pedagogical Content Knowledge (TPACK)? *Contemporary Issues in Technology and Teacher Education*, 9(1), 60–70. [Google Scholar] [Find it@NCCU](#)
9. Koehler, M. J., & Mishra, P. (2005). What happens when teachers design educational technology? The development of technological pedagogical content knowledge. *Journal of Educational Computing Research*, 32(2), 131–152. [Crossref], [Google Scholar] [Find it@NCCU](#)
10. Koh, J. H. L., & Chai, C. S. (2014). Teacher clusters and their perceptions of technological pedagogical content knowledge (TPACK) development through ICT lesson design. *Computers & Education*, 70, 222–232. [Crossref], [Web of Science ®], [Google Scholar] [Find it@NCCU](#)
11. Lederman, N. G. (1999). Teachers' understanding of the nature of science and classroom practice: Factors that facilitate or impede the relationship. *Journal of Research in Science Teaching*, 36(8), 916–929. [Crossref], [Web of Science ®], [Google Scholar] [Find it@NCCU](#)
12. Liu, Q., Zhang, S., & Wang, Q. (2015). Surveying Chinese in-service K12 teachers' technology, pedagogy, and content knowledge. *Journal of Educational Computing Research*, 53(1), 55–74. [Crossref], [Web of Science ®], [Google Scholar] [Find it@NCCU](#)
13. Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers College Record*, 108(6), 1017–1054. [Crossref], [Web of Science ®], [Google Scholar] [Find it@NCCU](#)

[Google Scholar] [Find it@NCCU](#)

5. Shulman, L. S. (1986). Those who understand: Knowledge growth in teaching. *Educational Researcher*, 15(2), 4–14. [Crossref], [Google Scholar] [Find it@NCCU](#)
6. Shulman, L. S. (1987). Knowledge and teaching: Foundations of the new reform. *Harvard Educational Review*, 57, 1–22. [Crossref], [Web of Science ®], [Google Scholar] [Find it@NCCU](#)
7. Stangl, A., Kim, J., & Yeh, T. (2014). 3D printed tactile picture books for children with visual impairments: A design probe. In *Proceedings of the 2014 Conference on Interaction Design and Children (IDC '14)*, (pp. 321–324). New York, NY: ACM. [Google Scholar] [Find it@NCCU](#)
8. Stoilescu, D. (2015). A critical examination of the technological pedagogical content knowledge framework: secondary school mathematics teachers integrating technology. *Journal of Educational Computing Research*, 52(4), 514–547. [Crossref], [Web of Science ®], [Google Scholar] [Find it@NCCU](#)
9. Tabachnick, B. G., & Fidell, L. S. (2007). *Using multivariate statistics* (5th ed.). Boston, MA: Allyn & Bacon. [Google Scholar] [Find it@NCCU](#)
10. Tournaki, N., & Lyublinskaya, I. (2014). Preparing special education teachers for teaching mathematics and science with technology by integrating TPACK framework into the curriculum: A study of teachers' perceptions. *Journal of Technology and Teacher Education*, 22(2), 243–259. [Google Scholar] [Find it@NCCU](#)
11. Voogt, J., Fisser, P., Roblin, N. P., Tondeur, J., & van Braak, J. (2013). Technological pedagogical content knowledge-A review of the literature. *Journal of Computer Assisted Learning*, 29, 109–121. [Crossref], [Web of Science ®], [Google Scholar] [Find it@NCCU](#)

environment. *IEEE Transactions on Learning Technologies*, 8(1), 31–42.

[Crossref], [Web of Science ®], [Google Scholar] [Find it@NCCU](#)

3. Wong, M. E., & Law, J. S. (2016). Practices of assistive technology implementation and facilitation: Experiences of teachers of students with visual impairments in Singapore. *Journal of Visual Impairment & Blindness*, 110(3), 195–200.

[Crossref], [Web of Science ®], [Google Scholar] [Find it@NCCU](#)

4. Xu, J., Kent, M., Ellis, K., & Zhang, H. (2016). Using social media to advance the social rights of people with disability in China. In K. Ellis & M. Kent (Eds.), *Disability and social media: Global perspectives* (pp. 318–332). New York: Routledge. [Google Scholar]

[Find it@NCCU](#)

5. Zhang, S. S. (2015). Using information technology to enhance the effect of geography teaching for blind students. *Journal of Modern Special Education*, 2, 32–33.

[Google Scholar] [Find it@NCCU](#)

6. Zhou, L., Ajuwon, P. M., Smith, D. W., Griffin-Shirley, N., Parker, A. T., & Okungu, P. (2012). Assistive technology competencies for teachers of students with visual impairments: A national study. *Journal of Visual Impairment & Blindness*, 106(10), 656–665. [Crossref], [Web of Science ®], [Google Scholar]

[Find it@NCCU](#)

7. Zhou, L., Smith, D. W., Parker, A. T., & Griffin-Shirley, N. (2011). Assistive technology competencies of teachers of students with visual impairments: A comparison of perceptions. *Journal of Visual Impairment & Blindness*, 105(9), 533–547.

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