Developing a Framework for Professional Teacher Technical Identity Development through Mobile Learning

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Abstract

Teacher identity development is an ongoing and dynamic process whereby individuals negotiate external and internal expectations as they make sense of themselves and their work as educators. With the advancements in technology education and the many studies being done to understand and provide a simplified yet effective implementation process, the role of teacher identity development is of crucial importance. This is due to the close connection between identity and practice. Numerous studies have focused on the contributing factors that influence technology integration and implementation in teaching. Several models have been created to understand technology acceptance amongst teachers and learners, but the identity development that takes place within a teacher has not been explored. This article provides a framework that can be used to evaluate professional teacher technical identity development (PTTID) using three existing models related to technology integration. The Technological. Pedagogical, Content Knowledge (originally TPCK) now known as Technology, Pedagogy, and Content Knowledge (TPACK), Technology Acceptance Model (TAM), and Substitution, Augmentation, Modification, Redefinition (SAMR) models were investigated to identify plausible links. An action research approach was applied to explore and identify common themes and trends that would lead to the development of a PTTID framework. This framework will provide a holistic approach to technology implementation and a logical understanding of the drivers for technology adoption amongst in-service teachers.

Keywords: mobile learning; technology acceptance; professional development; teacher technical identity development

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Introduction

"Individuals are considered to have multiple identities which are continually shaped by our social and cultural contexts, beliefs, prior experiences, and also by our professional contexts, including knowledge, skills, educational principles and ideology" (Francis et al. 2018, 133). Professional teacher identity can be defined as the way teachers identify themselves in the field of teaching (Lerseth 2013). Beijaard, Meijer and Verloop (2004) view teacher identity in terms of the knowledge that teachers need to possess, namely: subject matter knowledge; pedagogical knowledge; and didactical knowledge. There is a definite interrelationship between teachers' professional and personal identities and the "self" and "identity" (Day et al. 2006). The way teachers construe and construct their work is intimately linked to the events and experiences in their personal lives. This often plays a role in their professional performance (Day et al. 2006), thereby creating a change in their teacher identity. Izadinia (2014) illustrates the cyclic process of teacher identity development as an ongoing process. McKoen and Harrison (2010, 27) define identity as the "socially and culturally constructed 'self' formed through a life's experiences and through communication about these experiences". Alternatively, it can be seen as the way in which teachers organise their lives professionally and explain, justify and make sense of themselves in relation to others and the world around them (Anspal, Leijen and Lofstrom 2018; Crosswell and Beutel 2017). According to Kreber (2010), the interplay between personal theories of teaching, perceptions of self and social and occupational contexts, shape what is called "teacher identity".

The use of technology in teaching and learning has gained momentum (Al-Emran, Mezhuyev and Kamaludin 2018; Crompton and Burke 2018; Joo, Park and Lim 2018; Nikou and Economides 2017). This paradigm shift in education requires teachers to change their approaches and teaching methods. Several factors influence a teacher's decision to use technology, such as: access to resources; incentives to change; commitment to professional learning; quality of software and hardware; ease of use; the value added through the use of technology; and background informal training (Kihoza et al. 2016). Teachers need to be taught how to use information communication technology (ICT) and integrate it into their teaching at different levels (Goktas, Yildirim and Yildirim 2008). As a result, a pattern of technical growth and development needs to take place in a teacher, thus possibly altering their teacher identity. While several theories have been developed and documented, a framework for in-service teachers to gradually adapt to a 21st century method of teaching has not been developed.

In an attempt to bridge this gap and create a framework that will assist teachers in developing a change in teacher identity, three existing models were merged and explored to discover possible links that may exist. In order for technology to be implemented or integrated into teaching and learning, it needs to be acknowledged as an element of knowledge. The mode of teaching with mobile technology is used to demonstrate this integration. The following research question governed the current study: "How does mobile technology acceptance advancement shape professional teacher technical identity development?"

Literature Review

Over the last decade the use of Technological, Pedagogical. Content Knowledge (TPCK) (Mishra and Koehler 2006) (see figure 1) as a theoretical framework in educational research has increased rapidly, especially with the inclusion of ICT. A TPCK model originated from the initial Pedagogical Content Knowledge (PCK) model proposed by Lee Shulman in 1986. PCK was regarded as the dimensions of professional knowledge (Kirschner et al. 2016). Although Shulman's theory was modified several times the three dimensions of importance, namely content knowledge (CK), pedagogical knowledge (PK) and PCK were constant. The inclusion of technology allowed for an additional aspect which was proposed by Mishra and Koehler in 2006. It is presumed that technology, pedagogy and content cannot be taught in isolation from one another as it may compromise good teaching or successful technology implementation (Baia 2011). Kihoza et al. (2016, 108) define TPACK as "a tool for examining the pedagogically sound ways in which technology can support teachers' knowledge while keeping pace in the technology, content and pedagogy contexts". A teacher's role is to include technology into the learning process.

Thompson and Mishra (2007) renamed the framework to form a more integrated whole, namely, Technology, Pedagogy, and Content Knowledge with the acronym (TPACK) as it is known today. Baia (2011) refers to Mishra and Koehler (2006, 1030) who write that "viewing any of these components in isolation from the other represents a real disservice to good teaching", thus emphasising the restructuring of professional development for teachers to foster these interconnections. Baia (2011) further discusses how the adoption of instructional technology cannot be considered without content and pedagogy.

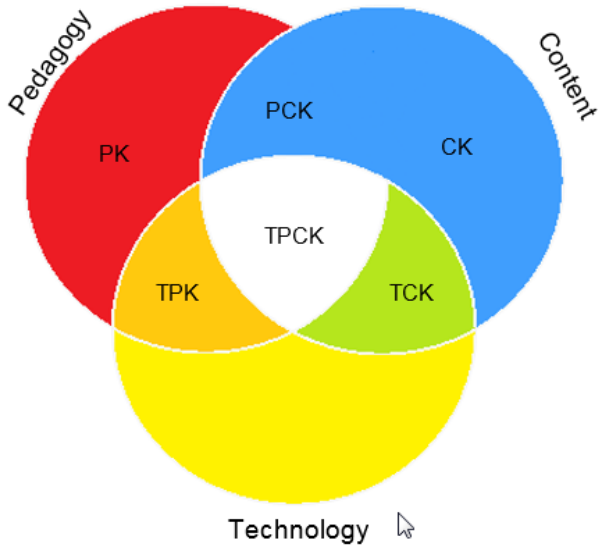


Figure 1: The TPCK model **(**Mishra and Koehler 2006)

Several studies have shown that PK drives the integration of technology into classroom practice (Koh and Chai 2014; Koh and Divaharan 2011; Liu 2013). Liu (2013) claims that teachers with sufficient PK and CK can consider various instructional technologies and are able to adopt a technology to match their notions of technological integration. His study integrated PK, CK and TK during a professional development programme and devised concepts of TPCK. Cox and Graham (2009) claim that TPACK inspires teachers, teacher trainers and education technologists to create a more meaningful way of effective instruction by good technology use, engaging pedagogy and meaningful content. TPACK provides this unifying framework that suggests that each of the three domains functions individually and collectively (Hilton 2015). The ability to understand how these domains work together and craft learning activities that will draw from each domain simultaneously is regarded as effective technology use (Hofer and Grandgenett 2012; Koehler and Mishra 2009) . The TPACK model is constantly changing as new technologies emerge and teachers try to find more effective ways to incorporate technology in their classrooms (Hilton 2015). Teachers need to think with flexibility to conceive all the uses of technology and remain consistent within their existing beliefs and subject expertise (Koehler and Mishra 2009).

Teo and Milutinovic (2015) found that the lack of sophisticated knowledge to support effective technology integration is one of the main reasons for the low ICT usage for teaching and learning by teachers. However, this has been mitigated by younger teachers who have shown attempts at teaching with technology (Dimitrijević, Popović and Stanić 2012). Teo and Milutinovic (2015) suggest that for teachers to act as change agents and

achieve educational goals, it is necessary that all teacher training faculties insist on one compulsory ICT course to provide professional development. Younger teachers display a higher level of aptitude and commitment to continuous education in using technology in their teaching and learning. This has been found to have significant impacts on the use of technology in teaching and learning (Teo and Milutinovic 2015). Studies conducted by Hermans (2008) and Pierce and Ball (2009) and identify technology acceptance as the key factor in ICT usage. The Technology Acceptance Model (TAM) (Davis 1989) has been found to be a robust and parsimonious model for understanding the factors that affect users' intention to use technology in education (Teo 2012).

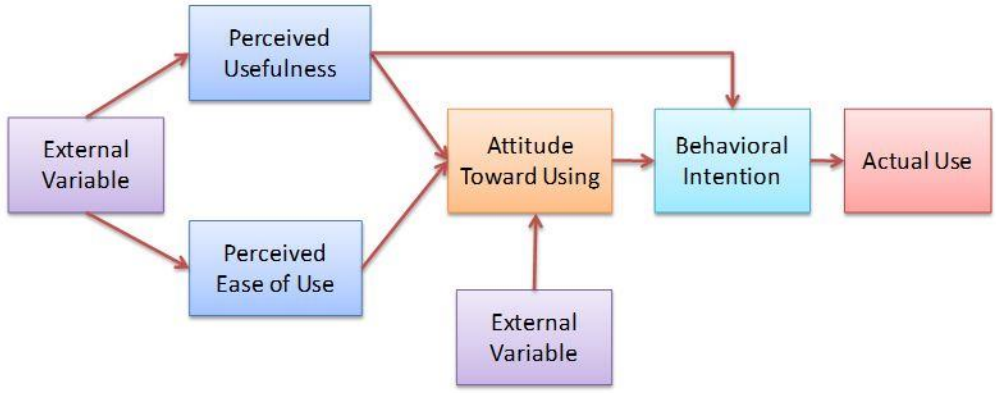


Figure 2: The TAM (MacCallum, Jeffrey and Kinshuk 2014)

The TAM (see figure 2) was developed by Fred Davis in 1989. This model has been changed and adapted in many studies by several researchers and has many links with other models (Adams, Nelson and Todd 1992; Davis, Bagozzi and Warshaw 1992; Hendrikson, Massey and Cronan 1993; Mathieson 1991). Davis drew on the Theory of Reasoned Action proposed by Fishbein and Ajzen (1977) where he realised that the beliefs and evaluation that a person makes impacts on their attitude. He then added the aspects of perceived usefulness (PU) and perceived ease of use (PEU). After a few studies he realised that PU and PEU had a direct influence on the behaviour of the individual. Venkatesh and Davis (2000) added the aspect of external variables as they found that there were several reasons as to why an individual would find a given system useful. Therefore, external variables appear twice in the model. The first type of external variables are regarded as the environmental or context type that plays a role in whether teachers find using technology useful or easy to use. The second mention of external variables refers to the teacher's internal beliefs of teaching with technology, influence of other colleagues, support and their ease in using the technology.

PU is regarded as the extent to which an individual believes a certain technology is useful to them in their lives, while PEU is regarded as the measure of the extent to which an individual believes a certain technology is effortless (MacCallum, Jeffrey and Kinshuk 2014). The individual's attitude to use is concerned with the desirability and evaluation of the information. The individual's behavioural intention is the likelihood of their carrying out the task successfully (Surendran 2012). Teo and Milutinovic's (2015) study proved that attitude has a significant influence on behaviour.

The TAM has been adapted by several researchers to include factors such as self-efficacy, perceived risk, social influence, experience, peer influence, compatibility, cognitive absorption, age, level of education, voluntariness, and so on to suit many studies on technology acceptance (Chuttur 2009; Park 2009; Surendran 2012). The TPACK model explains how technology fits into education while the TAM demonstrates the role of the teacher in the adoption process. It is also important to consider how lessons need to change if willing teachers and technology are available. This can be revealed by using the SAMR model. The TPACK model places the primary focus on the teachers, whereas the SAMR model focuses on the learners (Hilton 2015). However, the SAMR model provides the opportunity to design a more learner centred activity to imbed technology that will improve independent learning capacity (Hilton 2015).

Puentedura (2012) developed the Substitution, Augmentation, Modification, Redefinition (SAMR) model (see figure 3). The model provides a framework to identify and evaluate technology based activities and improve integration of these emerging technologies into everyday teaching (Hilton 2015). It is used to develop, design and infuse digital technology. As teachers and instructional designers implement mobile technology, it is of the utmost importance that they understand how mobile devices can improve learning. Often it is assumed that mobile devices are used to perform tasks that were previously performed without the use of a mobile device (Romrell, Kidder and Wood 2014). This assumption is incorrect as it only lends itself to the lowest level represented on the SAMR model. This model facilitates mobile learning (m-learning) activities and supports the transformation of learning. Cummings (2014) infers that the SAMR model should facilitate the acquisition of proficient software and modern consumer technologies that cater for teachers and learners and promote 21st century skills.

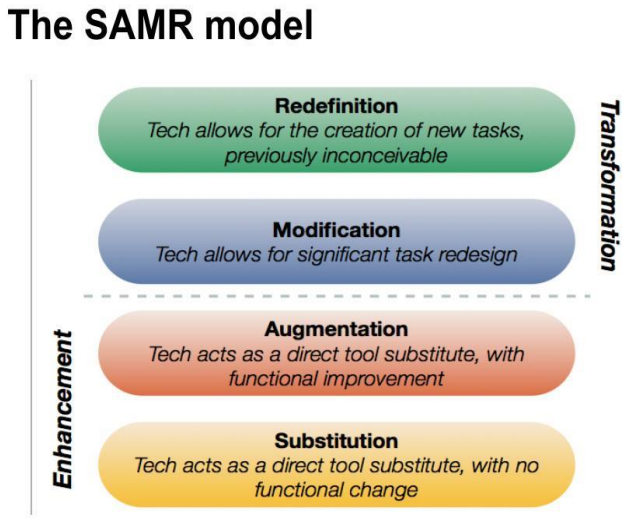


Figure 3: The SAMR model (Puentedura 2012)

The SAMR model is hierarchical and divided into four levels which are grouped in two different areas. Substitution and augmentation are grouped as "Enhancement" which means that they focus on using technology to replace or improve existing teaching and tools (Hilton 2015; Kirkland 2014). Modification and redefinition are grouped as "Transformation" which means that new opportunities for teaching and learning are provided which may not have been possible to take place without technology (Hilton 2015; Kirkland 2014).

To unpack the SAMR model it is necessary to understand what is occurring at each level and how it is used as a framework to evaluate m-learning. Kirkland (2014) explains the challenge that teachers face when trying to design a rich learning task with the use of technology as it adds an element of risk and uncertainty. For the SAMR model to be used as a framework to evaluate effective teaching, it needs to show the link between traditional teaching methods and m-learning. This link should emphasise the same outcomes for creation of knowledge (Kirkland 2014).

The four levels are:

1. **Substitution** is regarded as the easiest and simplest way to implement m-learning (Hockly 2013). An activity can be classified as substitution if it is possible to do the activity without the use of technology (Hilton 2015; Kirkland 2014).

2. **Augmentation** goes beyond the level of substitution as it involves some type of functional improvement over what could have been achieved by traditional methods (Hilton 2015; Kirkland 2014). The technology allows for some further improvement to the task that would not be possible if the technology was not used.
3. **Modification** is taking pre-existing tasks and altering them significantly so that they will not be achieved without technology (Hilton 2015; Kirkland 2014). The focus is on visual, audio and textual tools to share knowledge. This transforms learning by allowing the learners to share knowledge and by creating and analysing each other's work through a social means. They are then able to evaluate the explanations and reflect on their understanding. This prompts a slightly higher order of thinking in the learners so as to guide them to an outcome.
4. **Redefinition** is the creation of a new task that would not be possible without the use of technology (Hilton 2015; Kirkland 2014). The focus is on the visualisation of narrative aspects found in texts (Puentedura 2012; 2014). This allows for simulation redesign and real-time decision making by the learners. Each learner is able to participate individually thereby supporting the personalised nature of m-learning. The addition of feedback from other learners and the real-time decision making adds increased educational value for the activity. All the comments will allow for critical reflection by the learner and the ability to edit and re-design creates a platform for meaningful learning.

Recent studies have shown the link and application between the TPACK and SAMR models (see figure 4) when reflecting on the integration of technology in education (Hilton 2015; Kihoza et al. 2016). As illustrated and explained by Kihoza et al. (2016), the relationship between the two models is evident.

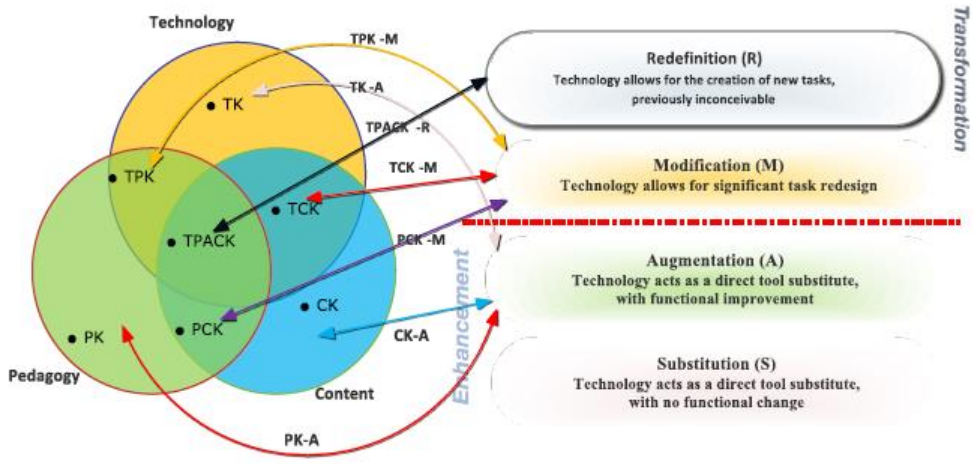


Figure 4: TPACK and SAMR model correlation (Kihoza et al. 2016)

Both models focus on the integration of technology into classroom practice. The TPACK model focuses more on the teachers' knowledge, whereas the SAMR model focuses more on the learners' activities (Hilton 2015). Even though both models may be sufficient for their individual purposes, the integration of the two models may fabricate the transformation and enhancement of educational tasks (Hockly 2012) and further clarify future educational technology use (Brantley-Dias and Ertmer 2013). These two models support a holistic view of what happens in education with regard to the holistic integration of technology into teaching and learning. The role of the teacher in the implementation is significant and it is therefore crucial to elaborate on how technology adoption is directly dependent on the teacher's willingness to accept change. The TAM was chosen to show the correlation between teacher acceptances of mobile technology.

Methodology

The current study consisted of three phases and followed a mixed method approach imbedded in a participatory action research. An inductive and deductive contextual analysis led to the revision and development of a professional teacher technical identity development (PTTID) framework. Fifteen teachers from different disciplines were purposefully selected from an urban school. The teachers' experience ranged from 1–35 years and they were all qualified to teach their subject.

Phase 1 of the study consisted of an extensive literature review to explore the existing literature and interrelationships between the constructs of each model. Phase 2 involved

an intervention where teachers were trained on tablet use, with regard to functionality; different educational apps; evaluation of apps; subject specific and generic apps; and methods of integrating technology into classroom practice. Prior to this intervention, the teachers were given a written questionnaire to complete to gain an understanding of their perceptions of mobile technology integration. Phase 3 consisted of the teachers implementing what they learnt during the intervention into their classroom practice. An online questionnaire and interviews with four of the 15 teachers were conducted to assess if there was any change in the teachers' perceptions once they were integrating technology into their teaching and what provoked these perceptions. The teachers were also expected to hand in lesson reflections of how they experienced teaching with technology over a 5-week period. This allowed the researcher to compare results from the two questionnaires and triangulate the findings with the responses given in the interview. This would serve as a means to track identity development and the lesson reflections would show possible development from week to week.

Data Collection

The written questionnaire consisted of Likert-type questions to explore the teachers' existing perceptions of mobile technology use. These questions were adapted from MacCallum, Jeffrey and Kinshuk (2014). The questionnaire was validated using a Cronbach's alpha test. The results depicted reliability values of above 0.5 which proved trustworthiness (Goforth 2015).

The online questionnaire was developed using scaled, ranked items and open-ended questions. These questions were developed by the researcher to check if the training workshop had an impact on the teachers' perceptions of teaching with technology. The results of the scaled and ranked items were analysed using SPSS and Minitab software. The open-ended questions uncovered their existing professional teacher technical identity.

The lesson reflections were analysed using content analysis and provided insight into how the teachers' perceptions changed from week to week. It clearly outlined the challenges they experienced and accomplishments that they made as they integrated technology into their teaching. Teacher reflection is crucial and is emphasised by Dewey (1910, 13) as turning "the thing over in mind, to reflect, means to hunt for additional evidence, for new data that will develop the suggestion, and will either, we say, bear it out or else make obvious its absurdity and irrelevance".

The interview questions were analysed using content analysis and were structured to triangulate the quantitative data and to confirm the open-ended questions. This qualitative method informed the study and allowed for the evident change in PTTID. An advantage of interviews is that they probe what is *in* someone else's mind and what is *on* someone else's mind (Batchelor 2001).

Data Analysis

For the purposes of this article, significant examples of the data are illustrated to demonstrate the statistical analysis that took place. Since the study followed a 3-phase approach the data was analysed in three phases. At the end of phase 3 a comparison between the results found in the written questionnaire and the online questionnaire was done. The intention was to reveal any differences between or similarities in the participants' technical identity before the workshop and after the workshop.

The Wilcoxon signed-rank test was used to test whether the differences between the questionnaires were significant or not (Field 2014). This non-parametric test is the counterpart to the well-known paired *t*-test and it was used in the study since the sample size was small. The reader is reminded that parametric tests are used with larger data sets and that non-parametric tests are used with smaller data sets.

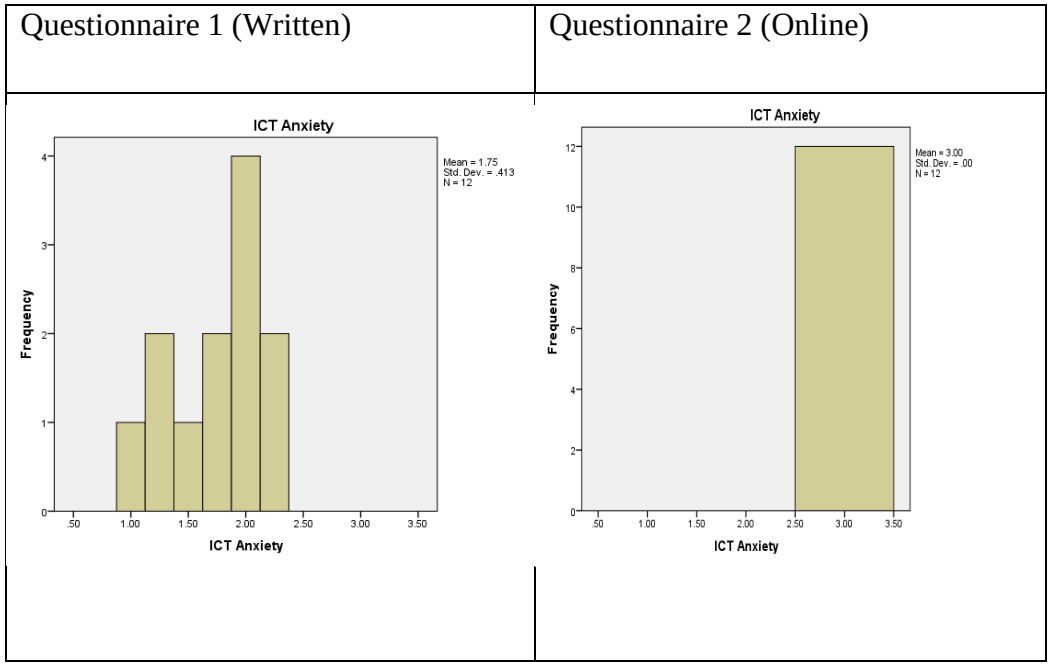


Figure 5: Histograms of ICT anxiety for both questionnaires

In order to see whether there were any statistically significant differences between the way the teachers answered the question on ICT anxiety, a Wilcoxon signed-rank test was performed (see figure 5). Since the Wilcoxon signed-rank test had a p-value < 0.05 ($Z = -3.075$, p-value = 0.002), there was a statistically significant difference between the responses on ICT anxiety between the questionnaires. For Questionnaire 1 the mean was 1.75 ($s = 0.413$) and for Questionnaire 2 the mean was 3.00 ($s = 0.000$) indicating

that the participants were more anxious after the workshop. In fact, since the standard deviation for the second questionnaire was zero, it showed that all the participants responded that they were anxious after attending the workshop.

Similar analysis was done for all the constructs of ICT ability, ICT attitude, PU and PEU. When analysing the ranking questions, graphs were plotted to demonstrate what the teachers' perspectives were in terms of level of importance. An example of what inspired them to teach with technology is given in figure 6.

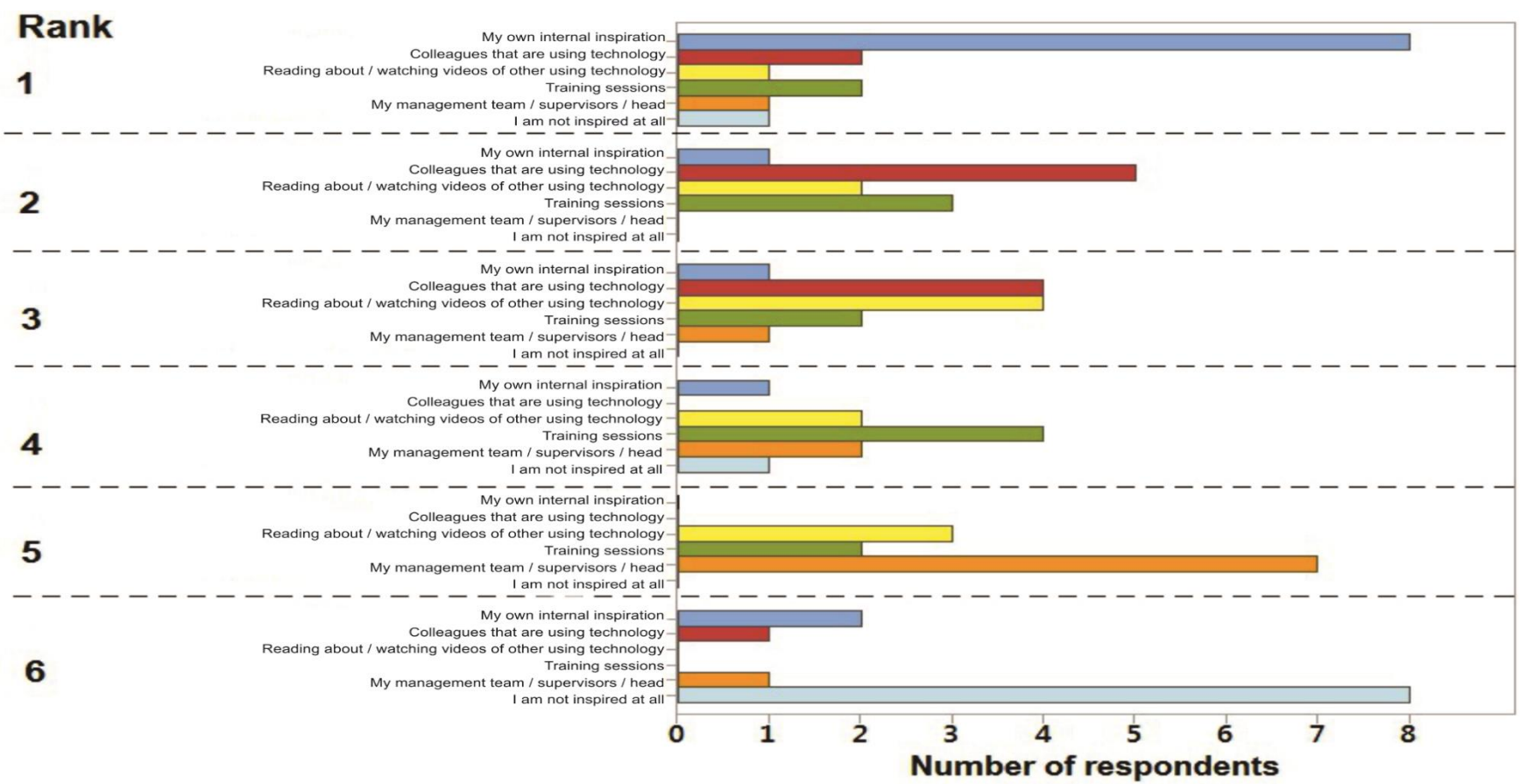


Figure 6: Inspiration to teach with technology

From figure 6 it can be seen that the teachers' own internal inspiration makes them want to teach with technology. This suggests that teaching with technology is voluntary. Interestingly, the teachers find colleagues who use technology to teach to also inspire them suggesting the subjective norm that if others find it important to use technology, they should consider using technology too. This highlights the level of support required for implementation as mentioned by Blignaut et al. (2010) and Summey (2013).

The responses from the teachers' lesson reflections and interviews showed the change in their professional teacher technical identity. The teachers mentioned how they initially felt anxious, nervous, frustrated, and so on, and that as they started to implement the mobile technology, they became more confident and comfortable. The following example of Fred is used to demonstrate the change and awareness of PTTID and the change in perceptions during the study.

Fred has always been positive about technology use and had been using it before the workshop. He finds it to be useful and has even had his learners reflect on the use of technology in his lessons. This way he can improve his lesson plans and use more advanced technology. Fred is very confident with using technology and mentions that teachers are often resistant and fearful towards technology use. He finds teaching with technology to be a "collective journey" with his learners and that this is a higher order process. Fred mentions that the scepticism, criticism and negativity of other staff tend to hinder his progress with using technology. He feels that learners are also often overwhelmed by teaching with technology and that it should be a gradual process of implementation because they need to understand how the technology works in order to interact with it. He has found the learners' response to be positive but teachers do not realise, "that by making mistakes and by the failures they were learning new things". Fred has the support of four other colleagues and they share ideas and assist each other. He also mentions that teachers use their subject as an excuse to not show initiative to integrate technology.

Fred has managed to teach lessons on the redefinition level but found that learners still want to be guided and that the use of technology in lessons is still relatively new to them. He has excellent ICT ability and ICT attitude. He has no ICT anxiety and finds technology to be useful and easy to use. He is not discouraged by facilitating conditions and works around them. He voluntarily uses technology and tries to develop further. He receives support from his colleagues and offers support to his colleagues. Figure 7 illustrates Fred's identity development.

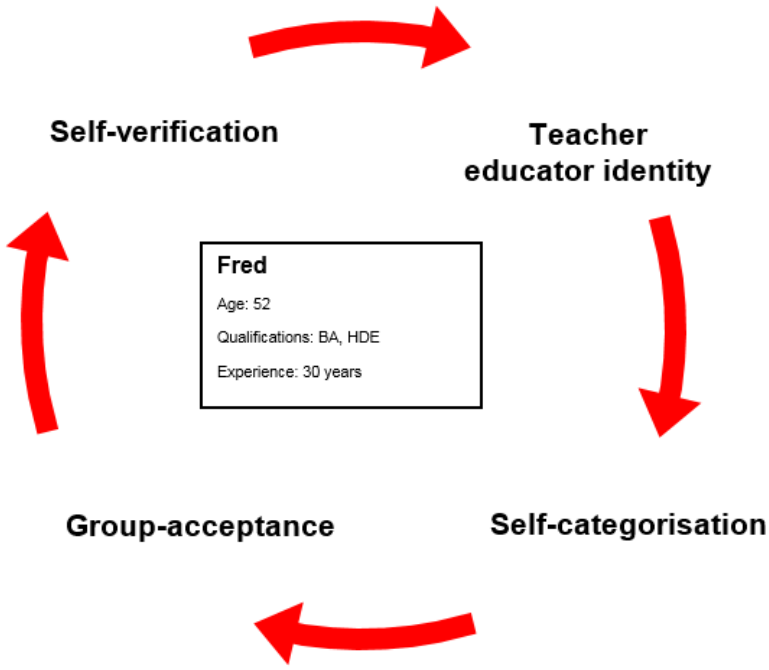


Figure 7: Summary of Fred's identity development

Fred's teacher identity is ever changing in that he is consistently developing and open to growing and learning more with and about technology use. He has a very positive attitude towards teaching in general and this encourages him to try different things. Fred believes that he offers his learners a different approach to learning by using technology. However, this approach is often criticised by his colleagues as it is different and they are resistant to the use of technology. He gains his self-verification from the response from his learners and also having attended the workshop. It has in many ways confirmed his belief that teaching with technology is beneficial and useful. Fred's teacher identity has changed in that he has developed new skills and is not complacent in his teaching methods. This is evident in his descriptive responses during the focus group discussions and interviews of lessons he has conducted. It has allowed him to actively source new methods and resources to transform his teaching.

Findings

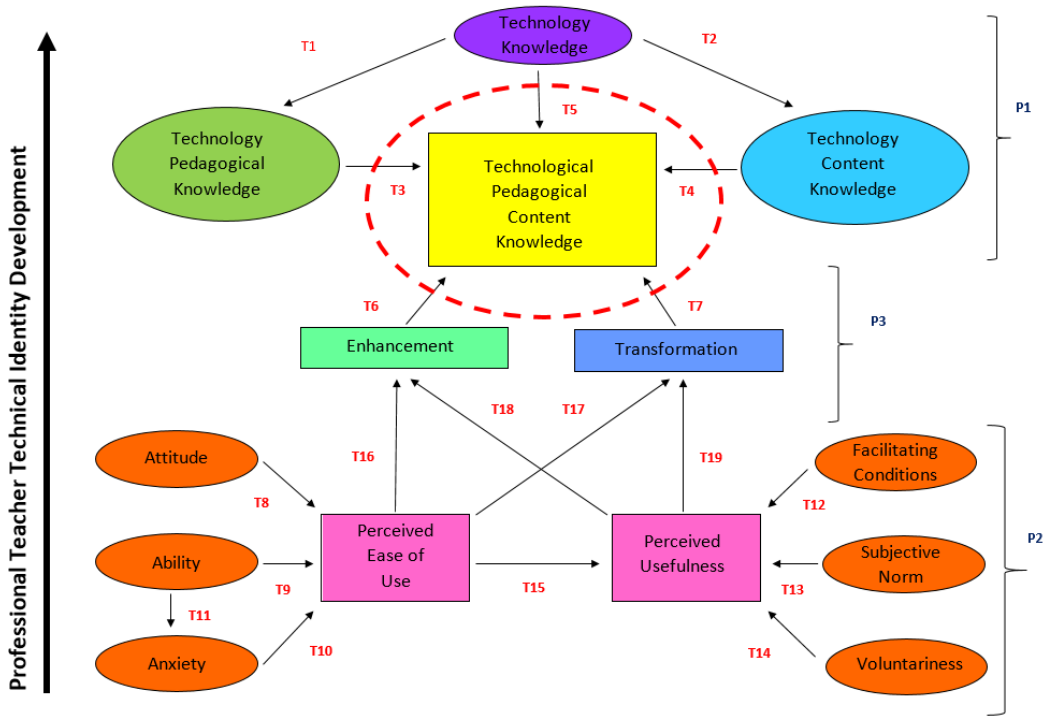
After consolidating all the data from the three phases, the researcher was able to identify the relationships between each factor and each framework to create a new theoretical framework. T1–T19 are used to represent the arrows showing the link between the

different constructs in the framework (see figure 8). It was evident that TPACK was the proposed outcome (**T1, T2, T3, T4, T5**) in terms of how teaching and learning should take place. To produce lessons that were technologically, pedagogically and content knowledge sound, teachers would need to receive training in all three aspects. Since technology knowledge is the newer element added to the original PCK framework, training for in-service teachers would be a crucial aspect in order to provide the skills of teaching with technology and teaching about technology. Ongoing professional development would enforce a more sound understanding of TCK (**T3, T4**) and TPK in a teacher as mere TK (**T5**) is insufficient for implementing mobile technology due to different learning areas and skills that it requires (Royle, Stager and Traxler 2014).

Since mobile technology requires the redesigning of lessons to suit the different levels of the SAMR model, teachers would need to decide if they wanted to use the technology to enhance the lesson or to transform the lesson (**T6, T7**). This is dependent on whether the teacher finds technology easy to use or useful (Chuttur 2009. Generally if the teacher finds technology ease to use, the teacher is more inclined to use technology. However, since all teachers' understanding of technology is different they may be able to design their lessons to enhance or transform teaching as they wish (**T16, T17**). Likewise, if teachers find technology useful, they are inclined to use the technology more. Consequently, this may enhance or transform their teaching as this is a personal choice (**T18, T19**). This was evident from the lesson reflections and focus group discussions.

Since teaching with technology is a personal choice, several factors contribute to the likelihood of technology integration and implementation. Three factors that impact on the teacher's perceived usefulness of technology are: facilitating conditions; subject norm; and voluntariness. The teachers need to want to use technology (voluntariness) (**T14**), need to have support to assist with this transition in their teaching (subjective norm) (**T13**) and need to have all the available resources in order to stay motivated (facilitating conditions) (**T12**). Similarly, in order for teachers to find it easy to use technology they need to have a positive attitude towards using it (ICT attitude) (**T8**); they need to have the necessary technological skills in terms of TPK and TCK to implement it (ICT ability) (**T9**); and they need to be comfortable, confident and proficient in technology use to avoid any form of anxiety (ICT anxiety) (**T10**). Usually if teachers find technology easy to use and are made aware of the benefits of using technology to teach, they often find technology useful as it adds new insight to their teaching. Often teachers who have low ICT ability tend to have high ICT anxiety, showing an interdependent relationship between these factors **(T11)**. Figure 8 illustrates a proposed theoretical framework that encapsulates all the aspects of technology integration needed for PTTID.

Figure 8: Proposed theoretical framework for PTTID



Limitations, Contributions and Recommendations

The current study was limited to a small sample and the results are not a generalisation. This framework can be used to test the PTTID in different contexts and a comparison can be made. Further, the findings of such a study in multiple contexts can inform policy and probe interventions for eliminating limiting factors to technology acceptance. The study also provided a unique methodological approach which include the value of intervention and community of practice to track PTTID. This method provides a guided structured approach to assist in-service teachers to implement technology through integration (Nkula and Krauss 2014). Even though this study does not change the action research methodology as such, it utilises action research to structure technical identity development within a community of practice. Methodologies of this magnitude have the capacity to engage teachers in communities of practices and creates opportunities that will allow them to work collaboratively/cooperatively.

Conclusion

Three phases of change take place (P1–P3). In order for teachers to develop their teacher identity, they first need some form of practical training (**P1**). Next, the six factors that contribute to the PU and PEU of technology need to be addressed. This, once identified

and supported, is usually reflected upon during community of practice sessions (**P2**). Once this is done, teachers are able to plan and deliver technology based lessons (Ally, Grimus and Ebner 2014). As the teachers gain experience and become more proficient in teaching with technology, they are likely to try new and more complex methods of integration due to their constant reflection in teaching practice (**P3**) **(**Beauchamp and Thomas 2009; Royle, Stager and Traxler 2014). During this process, a mind shift of teaching occurs as their teaching methods change. This means a change in planning, assessment, and delivery, during which the teachers develop a new identity of teaching. This change process is continuous and adapts as the teachers become more and more familiar with the technology use and start to achieve lessons that encompass all three elements of the TPACK model. This continuous, adaptable and consequent process of change in a teacher is known as professional teacher identity development. The inclusion of technology in teaching creates room for PTTID.

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