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# The myths and realities of Generational Cohort Theory on ICT Integration in Education: A South African Perspective

Research Paper

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## ABSTRACT

There is an assumption that the younger cohort of teachers who are considered to be digital natives will be able to integrate technology into their teaching spaces with ease. This study aims to determine if there is a difference between generational cohorts with respect to ICT (Information Communication Technology) integration in classrooms among South African teachers. There is a paucity of research on ICT integration in education with respect to generational cohorts. This study involved a secondary analysis of two primary data sets, which contained qualitative and quantitative data. The quantitative data revealed that there are few statistical differences between the generations with respect to their ICT usage in the classroom. However, the qualitative data revealed that younger cohorts of teachers appear to be highly concerned about classroom management, while a recurring theme amongst all cohorts was the lack of access and time.

## Keywords

Generational Cohort Theory, ICT Integration in Education.

## INTRODUCTION

This article explores the impact of generational cohorts on teachers' integration of ICT (Information Communication Technology) in their teaching spaces. There is an assumption that younger teachers are digital natives and thus will be able to integrate technology into their classrooms with ease. Mulder (2016) challenges this assumption. There is an assumption that older cohorts will be less likely to integrate ICTs into their classrooms and conversely that the younger generations will be more likely to integrate ICTs into their classrooms (Pegler, Kollwyn & Crichton, 2010). This assumption was challenged by a study conducted by Canadian researchers (n=1440), where it was found that there was no generational correlation in terms of ICT adoption by teachers (Pegler et al., 2010). This study aims to

determine if there is a difference between generational cohorts with respect to teachers and the integration of ICTs in their classroom within the South African context.

The generational cohort theory suggests that ‘several generations were distinguished based on the specific time periods into which people were born and the time periods they grew up in’ (Hemlin, Allwood, Martin & Mumford, 2014, p. 151). The aim of this study is to contribute to the body of knowledge by analyzing the ICT usage of teachers with respect to generational differences that exist. A cohort generation consists of individuals in a shared age bracket where they share a defined history and their personality and behaviour are shaped by that history (Strauss & Howe, 1991). Typically these generations are classified as Baby Boomers (born 1943 – 1960), Generation X (born 1961 – 1981), Generation Y (born 1982 – 1991) and Generation Z (born after 1992) (Johnston, 2013). However this study also aims to align the digital generations with generational cohorts unique to South Africa, consequently, the moderating role of age will be studied through this lens. Shirish, Boughzala and Srivastava (2016) suggest that considering generational attributes for phenomenon such as corporate social networks is ideally suited to form theories of technology adoption. McHenry and Ash (2010) conducted a study that examined differences among the generational cohorts with respect to knowledge management. They found that within the technology domain, the findings correspond with the stereotypes, that is that older generations use the intranet in a passive way and the younger cohorts use instant messaging, Share Point and social media. However, the study found minimal differences with respect to other areas such as connectedness, management support, and sharing. It appears that technology is a phenomenon in its own right. This implies that technology may provide a unique perspective compared to other societal factors with respect to studying different generations.

Given South Africa’s history of social division, it is clear that there is a need to conduct generational cohort studies in order to determine if these social inequities have been reduced (Jonck, Van der Walt & Sobayeni, 2017) over the 23 years of democracy. When the usage of ICT integration is found to be limited, the generational gap between the student and teacher is often used as an explanation, hence the solution is to institute a generational change (Albion, Jamieson-Proctor & Finger, 2011). Consequently, it is of significance to conduct generational research to obtain a more comprehensive picture of the status quo. Reports show that 45% of South African teachers are in the age range of 40 – 49 (Centre for Development and Enterprise, 2015), which implies that a huge cohort of teachers will be retired in 15 – 20 years time. Hence, it is essential to appreciate the generational gaps as this data may be used towards future planning. Reportedly, 49% of South African teachers who are leaving the profession are between the ages of 30 and 39 years (Parliamentary Monitoring Group, 2012). Therefore it is substantive to quantify the core skills (particularly digital competence) of the current cohort of teachers as they will be teaching Generation Z, who are the current cohort of learners (Fernández & Fernández, 2016). Understanding multigenerational teaching can help develop a cohesive working environment, which may help to retain and attract Generation Y educators (Fox, Bledsoe, Zipperlen & Fox, 2014). Further, in order for the concept of intergenerational learning to be exploited which involves the knowledge sharing between generations, it is imperative to understand how the generations differ (Geeraerts, Vanhoof & Van den Bossche, 2016). As Fox et al. (2014) point out, multigenerational settings can be useful to ensure collaborative learning.

There are a number of studies that consider the generational cohorts concept within higher education (Brown & Czerniewicz, 2010; Johnston, 2013; Sithole, Ikotun & Onyari, 2012) however this is conceivably the first study to consider generational cohorts within the South African context at school system level from a technological lens. There are a number of studies that have reflected on the effect of age on ICT integration in South African Schools. For instance, Mukhari (2016) considered the teachers

(n=15) experience of ICT usage, observing that older teachers tend to adhere to traditional methods of teaching. Bladergroen, Chigona, Bytheway, Cox, Dumas and Van Zyl (2012) aimed to unpack the discourses of teachers (n=40) around education and technology in poorly resourced schools (n=40) and reflected that older educators felt that they were lagging behind their younger colleagues. Chigona, Chigona, Kayongo and Kausa (2010) conducted a qualitative study on school educators (n =12) aimed to determine the factors that affect the ICT integration in schools. They found that older educators showed resistance and they did not trust the use of ICTs for teaching, however, they adopted a positive attitude after recognizing that technology can be useful to teaching and learning. Mathipa and Mukhari (2014) conducted a qualitative explorative study (n=10) to determine the factors that influence the use of ICTs in a South African school, where it was found that the older generation of teachers perceives impediments to ICT integration, due to anxiety or the inability to reconcile ICT with the subject matter. This emphasized that there may be a generational gap amongst teachers. Given the small sample sizes of the aforementioned studies, it is difficult to draw generalizations.

Obtaining deeper insights into ICT usage in this context will inform policy and help develop better guidelines to assist teachers in ICT usage in the classroom. Clearly, studies that consider the depth and breadth of the actual usage of digital tools from a generational cohort context are lacking. This is a significant research problem to address, as initiatives towards ICT integration can only be successful in encouraging teachers if they can identify and understand the influence of generational cohorts on ICT adoption. This leads to the main problem of the study addressed by this research namely: *To what extent does the generational age affect the ICT integration in the classroom?* To tackle this research question systematically, this study drew upon data collected by a previous study by the author, which aimed to determine the extent of ICT integration in South Africa. This survey includes data on teachers' (n = 113) experiences of ICT integration in the classroom. Secondary data analysis is the reanalysis of existing data (Clarke & Cossette, 2016). The rationale for the approach is predicated on the exploratory nature of the study and the fact that secondary analysis is useful towards cohort type studies (Kiecolt & Nathan, 1985).

This paper intends to contribute to the debates around the myth that digital native teachers (i.e. Generation Y) are more likely to use technology in their classrooms than digital immigrant (i.e. Baby Boomers or Generation X) teachers are. This belief also challenges the assumption that Generation X and Y teachers would automatically use technology in their classroom as they may be impeded by pedagogical understandings that previous generations possess (Pegler et al., 2010). This paper is organized as follows. Section 2 presents extant literature on the topic. Section 3 presents the theoretical framework for the present study. However, the generational cohorts will need to be defined within the South African context, which is the subject of Section 4. Section 5 explicates the research methodology used. Section 6 presents an overview of the South African e-education landscape. Section 7 presents the analysis of the data. Section 8 provides a discussion of the findings. Section 9 presents the implications for theory and practice. The article concludes in section 10 with possible future research opportunities.

## LITERATURE REVIEW

ICT integration is about providing pedagogically sound tools that promote new learning experiences, deep processing of ideas and increased student interaction with the subject matter (Earle, 2007). The term ICT refers to digital tools that are delivered via computers and the internet such as web resources, e-learning technologies, multimedia programs, etc. (Wang & Woo, 2007). ICT integration in the classroom is the perfect confluence of content knowledge (i.e. knowledge of subject matter), pedagogical knowledge (i.e. knowledge of teaching and learning praxis), and technological knowledge

(i.e. technical skills). This notion is analogous to Koehler and Mishra's (2009) framework known as the Technological, Pedagogical, and Content Knowledge (TPACK) model. ICT integration in the classroom is the utilization of any digital tool that enhances teaching and learning (Williams, 2003). Pegler et al. (2010) suggest that as technology evolves so rapidly, all teachers regardless of their generation need to keep *au courant* with technology in conjunction with pedagogical and content knowledge.

To the author's knowledge there are no studies that specifically consider the generational issue of ICT integration in South African schools, consequently, this review will consider related research. Czerniewicz and Brown (2005) conducted a quantitative survey of South African higher education educator (n=515) practices in the Western Cape. They found some differences concerning age, where the older staff report less frequent usage of ICTs in teaching and learning. It was found that 38% of those participants under 25 used ICTs in comparison to 28% of participants over 50. There were exceptions with respect to search engines and email usage. Remarkably, Czerniewicz and Brown (2005) found that staff over 40 and in junior positions tend to use ICTs least frequently. Johnston (2013) conducted a systematic analysis of the learning preferences of South African Net or iGenerations tertiary students (born after 1982) and the perception of academics of these learning preferences. This study found that academics need to include 'teaching methods which are interactive, social, visual, practical and immediate' in order to engage iGeneration students (Johnston, 2013, p. 271). Sithole et al. (2012) also considered the effect of generations on teaching and learning in an open distance-learning environment. To this end, a mixed model design was proposed to address the challenges of using technologies within each generation. As there are few empirical studies within the South African context, research conducted internationally is considered next.

Studies on generational differences appear to have contradictory findings. Pegler et al. (2010) who conducted a qualitative and quantitative study on Canadian teachers (n=1440) attempted to challenge the assumption that older teachers are less technologically perceptive than their younger cohorts. This study found that younger generations (Generation X) spent more time using computers and had a higher level of comfort specifically with multimedia type software. However, while this generation may know how to use technology, they do have issues with relating it to pedagogy. Both generations are able to use technology for communication. Pegler et al. (2010) suggest that while they found no generational differences with respect to the attitude towards ICT integration in the classroom, older generations are less willing to use social media in their classrooms than their younger cohorts (Generation X/Y). Ferrero (2002) found that using the generation divide was not useful towards analysis. Ferrero (2002) found that older teachers (Scotland, Sardinia, Greece) are more enthusiastic and had the patience to learn new skills, while the younger cohort of the teachers felt anxious as they are naturally expected to have expertise in ICT. Fox et al. (2014) conducted a qualitative study to determine the generational difference amongst Texas educators (n=112), in order to understand the challenges and benefits of multigenerational teaching. This study found that the older generation did not feel comfortable working with technology, however, older teachers considered multigenerational learning more useful towards improving their technological skills. Similarly, Hargreaves (2005) who conducted a study to determine the relationship between teacher (n=50) emotion and age based on the educational change, found that older cohorts are uncomfortable with new technological initiatives. While these studies are not conclusive, there is evidence to show generational differences. For completeness, other age-related studies are considered in the next elaboration.

Lei (2009) conducted a study on pre-service student teachers in a large northeastern university (United States) to determine the preparation required to integrate ICT into their classrooms and they found that having technical skills does not translate into meaningful integration. Consequently, they preferred

technologies that would aid in teaching content rather than communication type technologies. Fernández and Fernández (2016) aimed to analyze the level of ICT skills of teachers (n= 1,433) in primary and secondary schools in Madrid (Spain) which found that older teachers (56 – 66 years old) have a lower ICT teacher training profile than the younger cohort of teachers. Albion et al. (2011) conducted a study in Queensland (Australia) to determine the confidence level of using different forms of ICT among pre-service teachers (n=3200). They found significant differences by age group for some applications; however, they state that age-related differences should not be used as a basis for planning, as it is important to consider differences in access, experience, and confidence among age groups. Summak and Samancioglu (2011) aimed to determine the technology level of Turkish teachers (n= 232) with respect to gender and age and technology integration level in the classroom. This study found that there was only a significant difference between age and personal computer use, while there was no significant difference between age and level of technology implementation and current instructional practices.

There is also a noteworthy body of work on intergenerational learning, which considers how teacher generations can learn from one another. Geeraerts et al. (2016) conducted a qualitative study in order to determine how Flemish teachers (n=8) perceive colleagues from other generations. It appears that older cohorts have better content knowledge and better classroom management whereas the younger cohort appears to use more innovative teaching methods. The older cohort finds using ICTs time-consuming. The younger cohort considered the older generation as burned out and resistant to change. The older cohort perceives younger cohort as having a deeper connection with their students due to the reduced age difference. Polat and Kazak (2015) conducted a study to determine the perceptions of Düzce (Turkey) primary schools teachers (n=13) on intergenerational learning. They found that the younger generation looks to the older generation for guidance on classroom management and student behaviour while the older cohort needs assistance with newer technologies.

There appears to be no consensus regarding the significance of the differences between generations. While some studies suggest little to no significant differences (Pegler et al., 2010; Summak & Samancioglu, 2011) other studies indicate that generational differences are not particularly useful for analysis or for planning (Albion et al., 2011; Ferrero, 2002). Most studies concur that younger cohorts have advanced technical skills however they may be unable to transfer these skills into their teaching and learning (Lei, 2009; Pegler et al., 2010). This disconfirms Gallardo-Echenique, Marqués-Molíás, Bullen and Strijbos (2015) findings wherein they conducted a systematic review of ‘Digital Natives’ (born 1980 and 1994). They found that digital natives are not by default digitally competent. As most studies consider the attitudes and emotions (comfort), studies that consider the depth and breadth of the actual usage of digital tools are clearly warranted.

## **THEORETICAL FRAMEWORK**

Inglehart (1997) found that there was a correlation between the philosophy of materialism and periods of recession. Further, he noted these effects were transient but the values of a given birth cohort remain stable. The framing of a generational cohort theory is grounded on the principle that an individual’s philosophy is shaped by the period in which they are born, hence the ideas, sentiments, and values of members of the same cohort converge and evidently their actions as well (Ryder, 1965). Consequently, each generational cohort is unique as it is shaped by unique conditions that presided in their year of birth (Inglehart, 1997, p. 137). Hence, it is sensible to compare generational cohorts. The following subsections consider the various perspectives of the theory.

## **Strauss-Howe Generational Theory**

This theory views generations as cyclical (Strauss & Howe, 1991). Each generation is defined either as a prophet, nomad, hero, or artist which is repeated sequentially which implies that the characteristics of the next generation can be predicted (Hoover, 2009). Wilson and Gerber (2008) found that Strauss and Howe could not account for marginalized sectors of society in their analysis. DeChane (2014) states that the theory is limited as it does not explain the role of historical events, and these events cause unpredictable reactions and these reactions influences the next generation. Consequently, this theoretical lens was not considered practical for this study, as technology evolves.

## **Mannheim's Theory of Generations**

Mannheim surmises that a 'generation' is a 'particular kind of identity of location', embracing related 'age groups' embedded in a historical-social process' where a 'generation location is determined by the way in which certain patterns of experience and thought tend to be brought into existence by the natural data of the transition from one generation to another' (Mannheim, 1952, p. 292). Mannheim introduced the 'concept of generations as actuality' that is when people are born around the similar experiences and perceive themselves as constituting a generation (Bolin, 2017, pp. 25-26). The generational cohort theory which underpins this study has its foundations based on the Mannheim's theory of generations.

## **Generational Cohort Theory**

Sessa, Kabacoff, Deal and Brown (2007, p. 49) suggest that generational cohort theory, is based on the premise that individuals in the same age group at the same time (societal or historical) and space (location) will be limited 'to a specific range of potential experience' thereby predisposing them to a 'characteristic mode of thought and experience' and a characteristic 'historically relevant action'. Alwin and McCammon (2003, p. 26) describe the cohort effect as a 'distinctive formative experience which members of a birth cohort' share and which defines them. After reviewing empirical evidence, Inglehart (2008), found that the formative effect during younger birth cohorts is significantly different in comparison to older generations. The term cohort is often confused with generation. A cohort represents a group that shares a common connection (Markert, 2004). For example, all individuals that graduate from universities in the same year could be termed a 'graduating cohort' (Alwin and McCammon, 2003). The term birth cohort is synonymous with the term generation in this context. A cohort represents a group of individuals who have a shared experience of an event within the same time period (Ryder, 1965). The notion of the cohort effect will be used as a lens for the current study, however, there are limitations to using this theory.

## **Limitations of Generational Cohort Theory**

Young (2009), points out that there are two aspects to note with defining a generation; it is mutable and predicated on an individual's reflection. Brosdahl and Carpenter (2012) state that while it provides a useful segmentation of generations by age, it does not aid in understanding motivation. These dates used to delineate a generation are unclear as these can 'range from seven to ten years upwards to twenty years' (Markert, 2004, p. 11). Alwin and McCammon (2003) state that the cohort effect cannot account for whether a cohort difference is due to experience or maturity. Generational theory does not consider competitive explanations such as the maturational theory (Sessa et al., 2007). Campbell, Twenge and Campbell (2017) argue that there is no clear boundary between generations and argue for grouping people into broader categories to account for the boundary issues. Codrington (2008) provided a caveat

that the theory is more applicable to affluent populations. In this study, the top performing schools are under consideration. Pegler et al. (2010) categorically state that generations cannot be used as a predictor to determine whether teachers will infuse technology. Despite these limitations, the generational cohort theory has been applied to the South African context.

### **Exemplars of Generational Theory within the South African Context**

Knipe and Du Plessis (2005) cautioned against using generational theory in the South African marketing research domain, as they found few differences between Baby Boomers and Generation Xers with regard to values, activities, and opinions towards marketing ploys. Moore and Bussin (2012) conducted a study to determine whether each generation preferred a different reward strategy within the South African ICT industry; however, they found no variations among the generations. Jonck et al. (2017) found that there could be similarities and differences between South African generational cohorts with respect to work values. They found more similarities between Baby Boomers and Generation Yers in comparison to other cohorts. While in a longitudinal study Codrington (2008) found that where ages and race groups were correlated, ages are a greater predictor of attitudes and values than race. Petzer and De Meyer (2011) conducted a generations type study in South Africa to determine the differences in perceptions of service quality of cell phone service providers. This study showed that there are distinctions and that it is the younger generation who are more despondent with service providers. Clearly, there is no consensus on the value of generational cohort theory as it possibly depends on the context.

Arguably, the theory is more descriptive than predictive. Using these generational cohorts may be viewed as generalizations which may sometimes be limiting, however, they could be used to highlight trends (Oblinger & Oblinger, 2005). For example, Brown and Czerniewicz (2010) found that students' skills within the Generation Y cohort were not homogenous but rather diverse. Additionally, cohorts born in different generations may share values and attitudes even though they are subject to unique defining moments. Generational theory can help identify common characteristics in generations to gain deeper insight and can be useful towards understanding a group of people where there is scant information (Halse & Mallinson, 2009). Generations theory has a 'long and distinguished place in the social sciences' (Srinivasan, 2012, p. 49). When examining changes such as technological shifts, issues such as age and generational identity are valuable, as reform efforts concentrated in one generational group will have little impact on other groups (Hargreaves, 2005).

### **DEFINING GENERATIONS IN SOUTH AFRICA**

Lancaster and Stillman (2009) suggested that defining events and technology could be used to delineate a generation. The Westernized definition of cohorts may not be applicable in the South African context. 'Only where events occur in a way that demarcates a cohort can we speak of a generation' (Sessa et al., 2007, p. 49). South Africa's history was defined by several events that demarcated each generation: the Sharpeville Massacre (1960), the Soweto Uprising (1960) and the banning of the African National Congress (1960) (Jonck et al., 2017). Generation X in South Africa was marked by apartheid and economic and social instability (1965 – 1976) (Duh & Struwig, 2015). South Africa's Generation Y grew up during the transitional period and they are responsible for bridging the gap between the prejudice of the previous generations (Hewitt & Ukpere, 2012) and the current generation. Generation Y (1977 –1994) grew up in the post-apartheid era with more opportunities for education and employment



(Duh & Struwig, 2015), while Generation Z would be characterized by the Born-Free Generation in South Africa, that is, those individuals born after the dawn of democracy in South Africa (i.e. after 1994). Baby Boomers in South Africa were defined by the black resistance movement (1948 – 1960) (Jonck et al., 2017).

There is no consensus within South Africa regarding the cohorts for each generation. Lancaster and Stillman (2009) classified the generations as follows; Baby boomers (born 1946 – 1964), Generation Xers (born 1965 –1980), and the Millennials (born 1981 – 1999). While the generations theory may be more applicable to the western defining moments, Duh and Struwig (2015) showed that the defining moments in South African history are comparable. For instance, those that experienced the ‘economic and social instability’ of apartheid (born 1965 – 1976) can be compared with the Generation X Americans. It is contended that demographers can justifiably segment populations in South Africa into Baby Boomers (born 1945 –1964); Generation X (born 1965 – 1976); and the post-apartheid cohort; Generation Y (born 1977 –1994) (Duh & Struwig, 2015). A comparison of Generational Cohorts as classified by several authors is summarized in Table 1 and discussed in the following subsections.

**Table 1. A Comparison of Generational Cohorts**

Generations	(Oblinger & Oblinger, 2005)	(Codrington & Grant-Marshall, 2004)	(Duh & Struwig, 2015)	(Van Der Walt, 2010)	(Wessels & Steenkamp, 2009)	(Johnston, 2013)
Baby Boomers	1946 – 1964	1941 – 1960	1945 – 1964	1950-1969	1946-1964	1943-1960
Generation X	1965 -1982	1961-1980	1965 – 1976	1970-1989	1961-1981	1961-1981
Generation Y	1982 – 1991	1981 – 2007	1977 – 1994	1990-2005	After 1982	1982-1991
iGeneration/ Generation Z	-	-	-	-	-	After 1992
Generation C	-	-	-	-	-	1988-1993

## The Baby Boom Generation

Baby Boomers can be categorized as avoiders or reluctant adopters of digital media while on the other hand some may be labeled as eager adopters (Lerm, 2014). Television was the dominant medium that shaped the characteristics of the Baby Boomers (born 1946 – 1964). This generation relies on the post, courier services, telex and typewriters to communicate and they view education as a right (Moore & Bussin, 2012). In a study by Nyemba, Mukwasi, Mhakure, Mosiane and Chigona (2011) to determine the perception of Baby Boomers in South Africa towards social networking sites, it was found this generation did value obtaining the latest information, however, issues of security, privacy, and factors such as the lack of time and prohibitive costs were cited as barriers. They were most concerned about unsolicited content and the authenticity of information from social network sites like Facebook. Nyemba et al. (2011) found that Baby Boomers valued face-to-face or telephonic communication despite having access and the capacity to use social networking sites. There may be cultural differences that make it difficult for Baby Boomers to engage with younger generations on online platforms.

## Generation X

As with Baby Boomers, a large proportion were born before the digital age and are adopters of technology (Lerm, 2014). This generation relies on personal computers, the internet, email and cellular phones to communicate and they view education as the ability to be self-taught (Moore & Bussin, 2012). Wessels and Steenkamp (2009) describe Generation X as cohorts shaped by the television era and as

being more passive. With respect to technology, Generation Xers are expected to be au fait with mobile phones and social media, however, Generation Yers are completely enamored by them (Duh & Struwig, 2015).

## **Generation Y**

Generation Yers were born into the age of technology which is defined by considerable computer usage and constant communication via social media (Hewitt & Ukpere, 2012). South Africa's Generation Y is the first generation born into the internet age and they have access to social media services such as Facebook, MXIT, Twitter and YouTube (Bevan-Dye, Garnett & De Klerk, 2012). This generation relies on email, internet, web, SMS and voice recognition software to communicate and they view education as more than mere memorization (Moore & Bussin, 2012). Wessels and Steenkamp (2009) found that tertiary level Generation Y students in South Africa are more oriented towards images, customized experiences, multitasking and active learning than memorization tasks and linear text. Generation Y is strongly influenced by social media (Lerm, 2014). Within this generation is the concept of Generation C (i.e. the Content generation). This generation is characterized by having web access at their fingertips and the extensive use of apps to share content (Lerm, 2014). Brown and Czerniewicz (2010) found that South African higher education Generation Yers are not homogenous with respect to their computer experience. Wessels and Steenkamp (2009) suggest that the concept of 'Generation Y' may be a moving target depending on one's socio-economic status. It is suggested that those individuals that have been exposed to technology may be classified as the 'traditional Generation Y'. In their study, they suggest that educators will need to determine what proportions of students are true Millennials (i.e. true Generation Yers). However, Wessels and Steenkamp (2009) who conducted a study on Generation Y students in South Africa, found that the technological comfortableness score for Caucasian students was only slightly higher than that of ethnic students which they found surprising, given South Africa's history. They also found that ethnic students are more likely to use computers for games than their Caucasian counterparts. They concluded that 80% of their participants could be classified as being Generation Y.

## **iGeneration/ Generation Z**

Generation Z consists of cohorts born completely within the digital age (Lerm, 2014). They are also known as the iGeneration due to their reliance on the use the iPhone, iPod, iPad and their constant yearning for new devices (Waldron, 2012). As educators need to make learning interactive, social, visual and practical to engage iGeneration students, they need to use presentation software, social media tools, vodcasting, and mobile devices both in and out of the classroom (Johnston, 2013).

The majority of teachers are born within Generation X and Y and they are responsible for teaching Generation Z. Those generations (Generation Y or Generation Z) that are au fait with technology are classified as digital natives. While those generations (i.e. Baby Boomers or Generation X) that are less familiar with technology are classified as digital immigrants. A matrix of each generation's technological traits is summarized in Table 2. The next elaboration considers the digital ages in South Africa, as technology will also be used as a lens to delineate the generations.

**Table 2. Matrix of Generational and Technological Traits**

Generations	Characteristics	Technological Context	Preferences
The Baby Boom Generation	Digital immigrants (Lerm, 2014).	Television, computers modems (Pegler et al., 2010)	Print; snail mail; face-to-face dialogue; online tools and resources (Coppens, 2014).
The Generation X	Digital immigrants However, they may be digital adopters as well (Lerm, 2014).	Overwhelming media, digital and satellite TV, mobile phones, palm pilots, personal computers (Pegler et al., 2010)	Online; some face-to-face meetings; games; technological interaction (Coppens, 2014).
The Millennials / Generation Y	Digital Natives that 'thrive in communication via social sharing email and SMS'(Lerm, 2014).	Mobile technologies (Pegler et al., 2010) Have '24/7 access to instantaneous global news and information, virtual social networking (Facebook, MXIT), virtual social reporting (Twitter) and virtual social media (YouTube)'(Bevan-Dye et al., 2012).	Online; wired; seamlessly connected through technology (Coppens, 2014).
Generation Z / Generation I/ (Internet Generation)	Superficial Extraverts – socialization is done completely online hence, typical communication can be challenging with this generation (Lerm, 2014).	'Ubiquitous use of personal computers, tablets, and smartphones' (Kinash, Wood & Knight, 2013).	Online, texting, YouTube, apps and social networking (Kinash et al., 2013).

## The Digital Generation

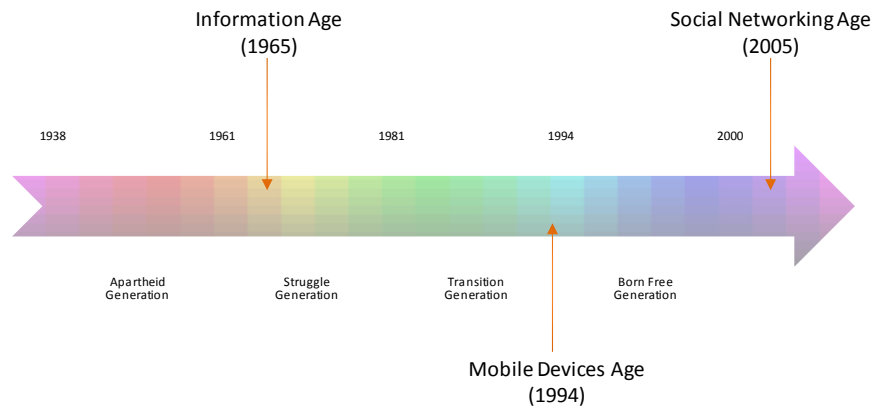
The first IBM computer was delivered to a brokerage firm in South Africa in 1959, while Rhodes University was the first university in South Africa to install a computer in 1965 (Mybroadband, 2015). Consequently, it may be considered that South Africa's *Information Age* began in 1965. In the South African context concerning ICT, it was found that the first domain name was registered in 1992 (FlatPress, 2015). Consequently, it may be considered that South Africa's *Internet age* began in 1992, and South Africa's first mobile phone was introduced in 1994 (Mybroadband, 2014). This may be considered the dawn of the *Mobile Devices* age. The notion of Social Networks began with Mxit in 2005 in South Africa, however, Mxit has long been surpassed by Facebook and Twitter (Feisal, 2015). It may be argued that the *Social Media age* began in 2005.

Deal, Stawiski, Graves, Gentry, Ruderman and Weber (2012) argued that the generations can be broken into the Apartheid Generation (born 1938–1960); the Struggle Generation (born 1961–1980); the Transition Generation (born 1981–1993) and the Born-Free Generation (born 1994 – 2000). While Johnston (2013) defined the set of cohorts for South African studies as follows – the Baby Boom generation (born 1943– 1960); Generation X (born 1961 – 1981); Net Generation (i.e. Generation Y born 1982 – 1991) and the iGeneration (born after 1991). Booyesen, Combs and Lillevik (2016) argued that the Apartheid Generation, the Struggle Generation, the Transition Generation and the Born-Free Generation roughly correlates with the Baby Boom, Generation X, the Net Generation and the iGeneration cohorts respectively as shown in Table 3.

**Table 3. Summary of the Generations (adapted from (Augustine, 2017; Deal et al., 2012; Johnston, 2013; Kinash et al., 2013)**

South African Generations	Generations	Alternative Names	Teachers/Students	The Digital Age
Apartheid Generation (1938-1960)	The Baby Boom generation (1943- 1960)	Late Digital Adopters	Teachers	-
The Struggle Generation (1961 - 1980)	Generation X (1961-1981)	Digital Immigrants	Teachers	Information Age (1965)
The Transition Generation (1981 -1993)	The Net Generation / Generation Y (1982-1991)	Digital Natives	Teachers	Internet Age (1992)
The Born-Free Generation (1994-2000)	iGeneration / Generation Z (born after 1991)	Net Generation	Students	Mobile Devices Age (1994) Social Media Age (2005)

In this study, it is argued that the South African generations devised by Deal et al. (2012) fit in more closely with the digital ages in South Africa. Hence the cohorts defined by Deal et al. (2012) will be used as a basis for the data analysis as demonstrated by Figure 1.



**Figure 1. Cohort Generations with the Digital Generation**

## RESEARCH METHODOLOGY

The range of data reported in this paper was collected as part of a larger study conducted as an extension of previous work (Padayachee, 2017), which involved a non-experimental exploratory research design, using a combination of quantitative and qualitative data collection methods. The study took place in 2016 (April – May) at various schools in Tshwane South. This study is a secondary analysis (or reanalysis) of the primary data collected during the exploratory study. This reanalysis aims to determine if there are any generational differences between the ICT integration in the classroom with respect to each of the identified generations (i.e. Apartheid, Struggle, and Transition excluding the Born-Free generation, as they are too young to be teachers).

Accordingly, the null hypothesis is:

**H1** *The hypothesis that there is no difference in the frequency of usage of ICTs between the Transition generation, the Struggle Generation, and the Apartheid generation is true.*

This study is based on an internal secondary analysis. The secondary analysis involves a reanalysis of information that is already available (Kolb, 2012). The originators of the research conducted the internal secondary analysis. Possible limitations of secondary data are as follows (Stevens, 2006) – poor fit to the research question; issues of accuracy and credibility of the information. However, as the originator of this research was involved in sourcing the primary data, it is not necessary to retest the quality and credibility of the information. The purpose of the original study, which involved the frequency of usage of ICT tools in the classroom, is maintained except that the analysis is done per cohort rather than per school. As this paper reinterprets existing datasets, the following subsections will initially discuss the original study.

### Sampling

The sampling strategy for collecting the primary data represented a combination of convenience and purposive sampling. The sampling criteria considered a confluence of relatively high access to the internet and top performing high schools in 2015 (based on the national senior certificate examination which is a standardized test), as this may generate best-case scenarios of ICT integration in education. As a convenience sampling method was followed, the City of Tshwane Metropolitan, which is located in the Gauteng Province, was selected based on accessibility and proximity as a possible target population. Purposive sampling was used in the study to build up a sample of 34 high schools that was satisfactory for this study. The questionnaire was administered to 551 teachers who used ICTs voluntarily.

The inclusion criteria for the present study involved all teachers that participated in the original study (n=124). The exclusion criteria involved eliminating those schools with low response rates (<20%) as this would skew the results due to non-response bias. Two schools were eliminated in the analysis as the numbers were too low to conduct any meaningful analysis or comparisons and as they probably served different communities. One participant was eliminated, as they did not indicate their age.

The secondary analysis considered the responses from 113 teachers.

## **Instrumentation**

The instrument used to collect the primary quantitative data consisted of two sections. Section 1 elicits the respondents' background information such as age, qualifications, and subject expertise. Section 2 contains two structured questions. These questions were adapted from Zawacki-Richter, Müskens, Krause, Alturki and Aldraiweesh (2015). The first structured question was based on the scale of digital tools, which was established as a sum scale of 40 items regarding the frequency of use of several digital learning formats (virtual seminars, web-based training, e-portfolios, etc.). These items were assessed by means of five-point Likert-scales (1=several times daily... 5=never). Section 1 and the first structured question were included in the secondary analysis. The responses from the second structured question, which was based on items related to the subjective benefits of digital tools, were excluded in this secondary analysis as there are plethoras of studies which consider these attitudes. The primary qualitative data was derived from a few open-ended questions adapted from Graham, Burgoyne, Cantrell, Smith, St Clair and Harris (2009) was included in the secondary analysis. These questions considered the use of digital technologies and possible barriers to the use of ICTs.

## **Validity & Reliability**

The tests for validity for the primary data included face validity and content validity. To ensure face and content validity the resulting survey was reviewed for clarity and correlation to research objectives by a statistician and a subject matter expert. The survey developed for the original research was also validated. Triangulation of the quantitative data and qualitative data can help validate and confirm the results. Triangulation has its limitations however when statistical results are not projectable then qualitative data helps to explain why (Holtzhausen, 2001).

## **Data Collection**

The administration of the questionnaire for the primary study was completed within a two-month (April – May) period in 2016. The data collection was administered by a field worker (on location) and collated by the author. Principles of beneficence and respect for human dignity were observed during data collection. The participant's right to confidentiality was maintained. The main challenge observed was the lack of cooperation of participants. Only 22% of the questionnaires were returned. The secondary analysis was conducted using the data collected from the original study; there were no contextual challenges as the originator of the research was also involved in the secondary analysis.

## **Data Analysis**

The primary data from the original study, which was captured in Microsoft Excel, was reanalyzed. Statistical analysis was performed using SPSS (Statistical Package for Social Sciences software Windows version 22). Descriptive statistics were used to conduct comparisons between the generational cohorts. Inferential statistics like Analysis of variance (ANOVA) and Mann-Whitney U-tests were used. ANOVA was employed to determine the statistical differences between three generational cohorts. A Mann-Whitney test was performed for comparison of the frequency of usage of digital tools between each generational cohort in order to identify specific differences. The qualitative data was captured according to themes in a Microsoft Excel Spreadsheet. This allowed the data to be sorted according to themes that were discovered during the primary analysis.

## THE SOUTH AFRICAN E-EDUCATION LANDSCAPE

In the *Action Plan to 2019: Towards the realisation of schooling by 2030* the DoE (Department of Basic Education (RSA), 2015, p. 17) reports that while there has been a slight improvement in the e-education landscape since 2011, ‘knowledge of e-education landscape as it currently exists remains limited’. In the *Action Plan to 2019* the DoE (2015) has clearly conceded that the adoption of technologies in the schooling system has not advanced as planned due to insufficiencies in the system. The growth of access to ICTs amongst learners has been slow – less than 40% of learners have access to a computer centre. The e-education policy goal is to ensure that every South African learner will be ICT capable (Department of Education (DoE), 2004). The DoE’s white paper on e-education (2004) spells out the framework, objectives, funding, resources, and implementation strategies for ICT integration in the classroom at a very basic level, however, the policy does not directly identify the type of technologies or pedagogy that could be used in the curriculum. This indicates that the practical enforcement of the e-education is clearly lacking (Vandeyar, 2015).

Leendertz, Blignaut, Ellis and Nieuwoudt (2015) attempted to develop a guideline for mathematics teachers to infuse ICT into their pedagogy. The authors claimed that they could not find an appropriate guideline. Du Plessis and Webb (2012, p. 46) state that current guidelines ‘provide very little information on how teachers and schools are expected to practically integrate or make use of ICT within the South African context’. There are several studies that consider the attitudes towards ICTs (Adegbenro, Gumbo & Olakanmi, 2017; Hart & Laher, 2015; Nkula & Krauss, 2014). There are also several studies that consider the challenges (Assan & Thomas, 2012; Cantrell & Visser, 2011). However, few descriptive studies explicate the e-education landscape in South Africa.

Molotsi (2014) who sampled the ICT competencies of secondary school teachers (n=8) from the North West Province, found that the tools used range from word processors, PowerPoint, the internet, emails, blogs, podcasts, instant messaging, Wikipedia, interactive white boards, CDs, digital media (simulations, animations) to smart phones (emails, blogs, videos etc.). Govender and Govender (2014), conducted a longitudinal study that involved a comparison of ICT usage in 2007 (n=153) versus 2014 (n=53) among science teachers in Kwa-Zulu Natal. This study found that internet usage increased in 2014 and that a large proportion of teachers (78%) know how to use the internet. They also found that all of the sampled teachers in 2014 were using technologies such as data projectors and word processing software; however, applications such as databases, web design tools, electronic resources and discussion groups, email and electronic references are still not widely used. The study found that a larger proportion of the sampled teachers were using the internet and PowerPoint in the classroom in 2014. The majority (over 80%) of these teachers did not use the available multimedia resources for teaching and learning.

Assan and Thomas (2012) conducted an empirical study on school-based commerce educators (n=138) from the North West Province, where they found that the majority of the respondents used software technologies such as word processors to format their course material. The study by Batchelor and Olakanmi (2015) involving 24 teachers found that the majority of the teachers do have basic computer skills. They use word processors and spreadsheets while a small proportion of the teachers (37.5 %) reported that they use the internet, however, only four teachers indicated that they use ICT for management purposes. Mooketsi and Chigona (2014) evaluated the implementation of an e-learning strategy in the disadvantaged areas of Cape Town using a case study method. Mooketsi and Chigona (2014) found that despite the challenges, teachers in South African schools within disadvantaged areas of Cape Town used word processors, PowerPoint, Excel (to capture marks), the internet, search engines (i.e. google) and interactive whiteboards.

Bladergroen and Buckley (2016) conducted a meta-analysis of the research done within the management of ICT in education in South Africa. They found that there is scant research on the management of ICT in education and the impact of the ICT usage, and further the didactics and pedagogy of the teaching realities is not clear. George and Ogunniyi (2016) assessed the availability of ICT resources in ten schools and the perceived intention of teachers to use ICTs (n=45) in Western Cape. They found that although there were sufficient resources, the frequency of ICT usage varied from 10% to 60%. Adegbenro et al. (2017) conducted a study on secondary school teachers (n=21) from Tshwane to determine their usage and attitudes towards ICTs. They found that most teachers had basic computing skills and they had a positive attitude to towards using ICT.

From the studies presented, it appears that most South African teachers have a basic knowledge of using computers, however, the use of ICTs in the classroom has not advanced. There is a need for more empirical studies to be conducted within the South African context. Obtaining deeper insights into ICT usage in this context will inform policy and help develop better guidelines to assist teachers in ICT usage in the classroom. Smith and Hardman (2014) indicate that there is a need for more qualitative studies to obtain a clear-cut representation of computer usage. Adegbenro et al. (2017) also state that there is a paucity of research done on the needs analysis of teachers, who intend to integrate ICTs in their classroom.

## DATA ANALYSIS

Statistical analysis was performed using SPSS (Statistical Package for Social Sciences software Windows version 22). Descriptive statistics used the mean and standard deviation, while inferential statistics depended on the ANOVA and the Mann-Whitney U test to reveal any significant association. The results were considered significant when the  $P$ -value was  $\leq 0.05$ .

### Sample Profile

The profile of the sample (n=113) is summarized in Table 4.

**Table 4. Sample Profile of the Participants**

Generations	Age Group	N	%
Apartheid Generation (1938-1960)	56 – 78	26	23%
The Struggle Generation (1961 – 1980)	36 – 55	40	35%
The Transition Generation (1981 -1993)	23 –35	47	42%
The Born-Free Generation (1994-2000)	16 –22	0	0%
Total N		113	100%

ANOVA was first performed to test for any significant differences among groups. There were no significant differences found as shown in Table 5. Thereafter the Mann-Whitney U test was used to determine if there were any specific differences. The level of significance was set at  $P < 0.05$  for all statistical tests. No significant differences across all the means were identified (ANOVA,  $F = 5.694$ ,  $p = 0.06 > 0.05$ ). Since the p-value is high we cannot reject the null hypothesis with an almost statistical certainty which confirms the difference in sample means.



**Table 5. Showing the results of the ANOVA Test**

ANOVA					
	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	79.000	111	.712	5.694	.006
Within Groups	1.000	8	.125		
Total	80.000	119			

## E-Learning Tools

This subsection presents side-by-side comparisons of the frequency of usage per e-learning tools per cohort. These items consist of tools specifically designed for e-learning.

### *Comparative Analysis between the Transition Generation and the Struggle Generation*

An overview of the comparative analysis between the Transition Generation and Struggle Generation is shown in Table 6.

**Table 6. A Comparative Analysis between the Transition Generation and Struggle Generation**

Items	Transition Generation		Struggle Generation		P-value
	MEAN	SD	MEAN	SD	
Internet-based learning platform	3.78	1.34	3.48	1.32	0.305
Online library services	4.10	1.12	4.23	1.17	0.535
E-Portfolios	4.49	0.73	4.32	0.76	0.348
Multimedia-based learning software	3.40	1.27	3.66	1.19	0.356
Free multimedia-based learning software	3.46	1.17	3.60	1.02	0.621
Video / Record lessons	4.00	1.11	3.83	1.14	0.483
Online examinations/tests	4.11	1.00	4.03	1.21	0.975
Virtual labs	4.62	0.84	4.88	0.41	0.111
Educational computer games	4.50	0.91	4.47	0.88	0.772
Computer Simulations	4.49	0.94	4.42	1.07	0.984
Presentation software	2.09	1.24	2.49	1.26	0.120
Word-processing programs	1.93	1.27	1.82	1.20	0.755
Spread sheet software	2.15	1.28	2.13	1.14	0.907
Graphic software	4.14	1.07	3.97	1.04	0.341
Audio software	4.66	0.62	4.62	0.85	0.855
Video editing software	4.65	0.64	4.52	0.68	0.311
Interactive Whiteboards	4.56	1.11	4.63	1.05	0.676
Data Projectors	2.26	1.55	2.16	1.44	0.907
Direct Access	3.68	1.41	3.68	1.37	0.971

Notes:  $p < 0.05$ , significant; Abbreviations: SD, Standard Deviation

The data distribution was similar for all the variables from both studied groups; thus, there was no significant statistical difference ( $p < 0.05$ ) when the Mann-Whitney test was used

### *A Comparative Analysis between the Struggle Generation and the Apartheid Generation*

An overview of the comparative analysis between the Struggle Generation and Apartheid Generation is shown in Table 7.

**Table 7. A Comparative Analysis between the Struggle Generation and the Apartheid Generation**

ITEMS	Struggle Generation		Apartheid Generation		p-value
	MEAN	SD	MEAN	SD	
Internet-based learning platform	3.48	1.32	4.11	1.17	0.083
Online library services	4.23	1.17	4.56	0.68	0.506
E-Portfolios	4.32	0.76	4.73	0.57	0.063
Multimedia-based learning software	3.66	1.19	4.20	0.93	0.097
Free multimedia-based learning software	3.60	1.02	3.95	1.17	0.186
Video / Record lessons	3.83	1.14	4.37	0.81	0.076
Online examinations/tests	4.03	1.21	4.23	0.95	0.782
Virtual labs	4.88	0.41	4.60	1.02	0.287
Educational computer games	4.47	0.88	4.53	0.99	0.655
Computer Simulations	4.42	1.07	4.42	1.11	0.937
Presentation software	2.49	1.26	3.25	1.39	0.038*
Word-processing programs	1.82	1.20	2.16	1.32	0.223
Spread sheet software	2.13	1.14	2.46	0.96	0.191
Graphic software	3.97	1.04	4.61	0.68	0.013*
Audio software	4.62	0.85	4.93	0.26	0.174
Video editing software	4.52	0.68	4.61	0.83	0.358
Interactive Whiteboards	4.63	1.05	4.71	0.75	0.730
Data Projectors	2.16	1.44	3.04	1.49	0.027*
Direct Access	3.68	1.37	4.30	1.10	0.096

Notes:  $p < 0.05$ , significant; Abbreviations: SD, Standard Deviation

There was a statistical difference between the Struggle Generation and the Apartheid Generation with respect to: presentation software (Mann-Whitney U test= 315.500;  $p=0.038 < 0.05$ ); graphic software (Mann-Whitney U Test = 186.500;  $P=0.013 < 0.05$ ) and data projectors (Mann-Whitney U Test = 300.000;  $p = 0.027 < 0.05$ ). The data distributions were similar for all the variables from both studied groups.

### *A Comparative Analysis between the Transition Generation and the Apartheid Generation*

An overview of the comparison between the Transition Generation and Apartheid Generation is shown in Table 8.

**Table 8. A Comparative Analysis between the Transition Generation and the Apartheid Generation**

ITEMS	Transitional Generation		Apartheid Generation		P-value
	MEAN	SD	MEAN	SD	
Internet-based learning platform	3.78	1.34	4.11	1.17	0.456
Online library services	4.10	1.12	4.56	0.68	0.191
E-Portfolios	4.49	0.73	4.73	0.57	0.200
Multimedia-based learning software	3.40	1.27	4.20	0.93	0.020*
Free multimedia-based learning software	3.46	1.17	3.95	1.17	0.111
Video / Record lessons	4.00	1.11	4.37	0.81	0.278
Online examinations/tests	4.11	1.00	4.23	0.95	0.720
Virtual labs	4.62	0.84	4.60	1.02	0.842
Educational computer games	4.50	0.91	4.53	0.99	0.836
Computer Simulations	4.49	0.94	4.42	1.11	0.918
Presentation software	2.09	1.24	3.25	1.39	0.002*
Word-processing programs	1.93	1.27	2.16	1.32	0.320
Spread sheet software	2.15	1.28	2.46	0.96	0.156
Graphic software	4.14	1.07	4.61	0.68	0.090
Audio software	4.66	0.62	4.93	0.26	0.128
Video editing software	4.65	0.64	4.61	0.83	0.867
Interactive Whiteboards	4.56	1.11	4.71	0.75	0.990
Data Projectors	2.26	1.55	3.04	1.49	0.038*
Direct Access	3.68	1.41	4.30	1.10	0.093

Notes:  $p < 0.05$ , significant; Abbreviations: SD, Standard Deviation

There was a statistical difference between the Transition Generation and the Struggle Generation with regard to multimedia-based learning software (Mann-Whitney U test= 271.500;  $p = 0.020 < 0.05$ ); presentation software (Mann-Whitney U test= 298.500;  $p = 0.002 < 0.05$ ) and data projectors (Mann-Whitney U test= 402.000;  $p = 0.038 < 0.05$ )

All three generations used the following tools most frequently: word-processing programs; presentation software; spreadsheet software and data projectors. However, the Apartheid generation used these tools much less frequently than the other two cohorts.

### General Web Services and Tools

This subsection presents a side-by-side comparison of the frequency of usage of general web services and tools per cohort. These tools are not specifically designed for e-learning.

#### *A Comparative Analysis between the Transition Generation and the Struggle Generation*

An overview of the comparison between the Transition Generation and Struggle Generation is shown in Table 9.

**Table 9. A Comparative Analysis between the Transition Generation and the Struggle Generation**

ITEM	Transition Generation		Struggle Generation		P-value
	Mean	SD	Mean	SD	
File sharing	3.76	1.31	3.57	1.13	0.300
Podcasts/Vodcasts	4.37	0.97	4.55	0.80	0.450
Online internal forums/newsgroups	4.41	0.89	4.36	0.95	0.842
Mailing lists	3.81	1.26	3.64	1.36	0.616
Virtual seminars/webinars	4.75	0.54	4.94	0.25	0.099
Social Media	3.22	1.69	3.46	1.59	0.606
Online Slide Sharing Community	4.46	0.81	4.81	0.46	0.044*
Online video sharing sites	3.51	1.24	3.69	1.26	0.490
Blogs	4.43	0.95	4.48	0.93	0.776
Search Engines	1.96	1.16	1.72	0.93	0.401
Your own self-created website	4.67	0.91	4.25	1.22	0.103
3D Virtual Worlds	4.87	0.52	4.93	0.26	0.920
Collaborative Project tools	4.28	1.04	4.52	0.91	0.261
Class wiki	4.77	0.53	4.76	0.82	0.444
Remote access	3.57	1.43	3.63	1.51	0.797

Notes:  $p < 0.05$ , significant; Abbreviations: SD, Standard Deviation

There was a statistical difference between the Transition Generation and the Struggle Generation with regard to the online slide sharing community (Mann-Whitney U test= 489.000;  $p = 0.044 < 0.05$ ) tools.

### *A Comparative Analysis between the Struggle Generation and the Apartheid Generation*

**Table 10. A Comparative Analysis between the Struggle Generation and the Apartheid Generation**

ITEMS	Struggle Generation		Apartheid Generation		P-value
	Mean	SD	Mean	SD	
File sharing	3.57	1.13	4.14	1.12	0.017*
Podcasts/Vodcasts	4.55	0.80	4.80	0.54	0.157
Online internal forums/newsgroups	4.36	0.95	4.65	0.59	0.335
Mailing lists	3.64	1.36	4.06	1.64	0.103
Virtual seminars/webinars	4.94	0.25	4.67	0.60	0.054
Social Media	3.46	1.59	3.65	1.31	0.813
Online Slide Sharing Community	4.81	0.46	4.53	1.02	0.359
Online video sharing sites	3.69	1.26	3.60	1.11	0.683
Blogs	4.48	0.93	4.59	0.60	0.931
Search Engines	1.72	0.93	2.29	1.10	0.034*
Your own self-created website	4.25	1.22	4.44	1.07	0.680
3D Virtual Worlds	4.93	0.26	4.93	0.26	0.976
Collaborative Project tools	4.52	0.91	4.80	0.40	0.410
Class wiki	4.76	0.82	5.00	0.00	0.202
Remote access	3.63	1.51	4.11	1.25	0.344

Notes:  $p < 0.05$ , significant; Abbreviations: SD, Standard Deviation

An overview of the comparison between the Transition Generation and Struggle Generation is shown in Table 10. There was a statistical difference between Struggle Generation and the Apartheid Generation with regard to file sharing (Mann-Whitney U test= 250.000;  $p = 0.017 < 0.05$ ) and search engines (Mann-Whitney U test = 327.500;  $p = 0.034 < 0.05$ ).

### *A Comparative Analysis between the Transition Generation and the Apartheid Generation*

An overview of the comparison between the Transition Generation and Struggle Generation is shown in Table 11.

**Table 11. A Comparative Analysis between the Transition Generation and the Apartheid Generation**

ITEM	Transition Generation		Apartheid Generation		P-value
	Mean	SD	Mean	SD	
File sharing	3.76	1.31	4.14	1.12	0.275
Podcasts/Vodcasts	4.37	0.97	4.80	0.54	0.060
Online internal forums/newsgroups	4.41	0.89	4.65	0.59	0.406
Mailing lists	3.81	1.26	4.06	1.64	0.158
Virtual seminars/webinars	4.75	0.54	4.67	0.60	0.599
Social Media	3.22	1.69	3.65	1.31	0.423
Online Slide Sharing Community	4.46	0.81	4.53	1.02	0.502
Online video sharing sites	3.51	1.24	3.60	1.11	0.820
Blogs	4.43	0.95	4.59	0.60	0.873
Search Engines	1.96	1.16	2.29	1.10	0.153
Your own self-created website	4.67	0.91	4.44	1.07	0.294
3D Virtual Worlds	4.87	0.52	4.93	0.26	0.911
Collaborative Project tools	4.28	1.04	4.80	0.40	0.086
Class wiki	4.77	0.53	5.00	0.00	0.082
Remote access	3.57	1.43	4.11	1.25	0.170

**Notes:**  $p < 0.05$ , significant; **Abbreviations:** SD, Standard Deviation

There was no statistical difference between the Transition Generation and the Apartheid Generation with respect to web services and tools. The data distribution was similar for all the variables from both studied groups; thus, there was no significant statistical difference ( $p < 0.05$ ) when the Mann-Whitney test was used.

Search engines were the most frequently used tool amongst all cohorts.

### **Other Miscellaneous Tools**

This subsection presents a side-by-side comparison of the frequency of usage of mobile tools and research-based tools per cohort.

### *A Comparative Analysis between the Transition Generation and the Struggle Generation*

An overview of the comparison between the Transition Generation and Struggle Generation is shown in Table 12.

**Table 12. A Comparative Analysis between the Transition Generation and the Struggle Generation**

ITEMS	Transition Generation		Struggle Generation		P-value
	Mean	SD	Mean	SD	
Bring your own device	2.70	1.61	2.38	1.55	0.354
Mobile learning tools and applications	2.91	1.70	1.89	1.45	0.008*
Software referencing packages	4.39	0.79	4.88	0.32	0.007*
Statistical software	4.64	0.71	4.55	1.00	0.971
Software for qualitative text analysis	4.66	0.67	5.00	0.00	0.013*
Downloadable eBooks and electronic texts	4.05	1.06	3.58	1.39	0.165

**Notes:  $p < 0.05$ , significant; Abbreviations: SD, Standard Deviation**

There was a statistical difference between the Transition Generation and the Struggle Generation with respect to mobile learning tools and applications (Mann-Whitney U test= 601.500;  $p = 0.008 < 0.05$ ), Software Referencing packages (Mann-Whitney U test= 316.500;  $p = 0.007 < 0.05$ ) and software for qualitative analysis (Mann-Whitney U test= 324.000;  $p = 0.013 < 0.05$ ).

### *A Comparative Analysis between the Struggle Generation and the Apartheid Generation*

An overview of the comparison between the Transition Generation and Struggle Generation is shown in Table 13.

**Table 13. A Comparative Analysis between the Struggle Generation and the Apartheid Generation**

ITEM	Struggle Generation		Apartheid Generation		P-value
	Mean	SD	Mean	SD	
Bring your own device	2.38	1.55	3.08	1.63	0.124
Mobile learning tools and applications	1.89	1.45	3.00	1.69	0.012*
Software referencing packages	4.88	0.32	4.92	0.28	0.768
Statistical software	4.55	1.00	4.64	0.61	0.726
Software for qualitative text analysis	5.00	0.00	4.80	0.40	0.026*
Downloadable eBooks and electronic texts	3.58	1.39	4.14	1.08	0.123

**Notes:  $p < 0.05$ , significant; Abbreviations: SD, Standard Deviation**

There was a statistical difference between the Struggle and the Apartheid Generation with respect to mobile learning tools and applications (Mann-Whitney U test = 283.500;  $p = 0.012 < 0.05$ ) and software for qualitative analysis (Mann-Whitney U test = 96.000;  $p = 0.026 < 0.05$ ).

### *A Comparative Analysis between the Transition Generation and the Apartheid Generation*

An overview of the comparison between the Transition Generation and Apartheid Generation is shown in Table 14.

**Table 14. A Comparative Analysis between the Transition Generation and the Apartheid Generation**

ITEM	Transition Generation		Apartheid Generation		P-value
	MEAN	SD	MEAN	SD	
Bring your own device	2.70	1.61	3.08	1.63	0.421
Mobile learning tools and applications	2.91	1.70	3.00	1.69	0.806
Software referencing packages	4.39	0.79	4.92	0.28	0.031*
Statistical software	4.64	0.71	4.64	0.61	0.772
Software for qualitative text analysis	4.66	0.67	4.80	0.40	0.735
Downloadable eBooks and electronic texts	4.05	1.06	4.14	1.08	0.625

Notes:  $p < 0.05$ , significant; Abbreviations: SD, Standard Deviation

The only statistical difference between the Transition Generation vs the Apartheid Generation is the use of software reference packages (Mann-Whitney U test 140.500;  $p = 0.031 < 0.05$ ).

The most popular tools among all three generations were bring your own devices and mobile learning tools and applications. The Struggle Generation was inclined to use these types of tools most frequently in comparison to all groups.

## Qualitative Analysis

The qualitative analysis was based on the responses to the open-ended questions.

### *Apartheid Generation*

Most of the main reasons cited by the Apartheid Generation included the lack of internet access. A few mentioned their lack of skills. Cases in point include:

Participant #A11: "...cannot operate them"

Participant #A14: "lack of knowledge of technologies"

Participant #17: "Time to learn how to use it. Time to prepare. Some pupils don't have access to more sophisticated devices"

Participant #A19: "Time!! (to make PowerPoint lessons take time!!) Children get too soon to used to p.point[sic] lesson"

Participant #A21: "my own ignorance"

### *Struggle Generation*

Most of the main reasons cited by the Struggle Generation included poor or no internet access in the classroom. Many of them mentioned their lack of skills and time. Cases in point include:

Participant #S7: "...knowledge is experience. If you do not know what is on the market and don't how to use it you miss out"

Participant #S15: "...difficult to teach an old dog new tricks (Especially if it is a stubborn dog)"

Participant #S17: “lack of experience (and insight/understanding of various tools/training) & confidence. Time!!? (Too much work, prep and extramural activities, marking!!!) even for training. Expectation to understand and apply all asap (pressure). Periods are too short and interrupted to effectively apply use of some technological tools (ppts/ youtube...)”

Participant #29: “Time; syllabus is so full – wish we can use all these methods”

Participant #S32: “Time to be trained. There are too many programmes, which speedily undergo changes”

### *Transition Generation*

While the Transition Generation cited the same problems as above and they used mostly the same technologies as the previous generations, they do tend to use social media apps such as WhatsApp slightly more than the previous generations. This generation cited not having enough time to prepare a lesson with technology. Cases in point include:

Participant #T11: “Time and money”

Participant #T17: “Takes time to set up technology”

Participant #T19: “Technology sometimes fails to work and it takes time to set up”

Participant #T21: “Time to prepare lesson”

Participant #T25: “Setting up the data projector, getting started”

This generation, unlike previous generations, mentioned their concerns regarding the learner's lack of literacy, tools, and discipline. Cases in point include:

Participant #T8: “...children without technologies [sic]”

Participant #T13: “...interactivity between the learners and technology”

Participant #T24: “Digital literacy skills of learners”

Participant #T27 “...not all learners having access to tablets discipline could become an issue because they might play games on the tablets”

Participant #T33: “Learners don’t have access to technology. Some don't even have cell phones”

Participant #T35: “Students do not make use of hard copy books any more computers do everything for them so they cannot read or even research properly using books”

Participant #T42: “It distracts children. They use it for other purposes! The technology may be too complicated. Difficulties bring the whole class to a standstill.”

Participant #T46: “Time and to get learners to concentrate again after a youtube video”

Only one participant (#T43) indicated that “Knowledge of internet resources” was an issue.

The main issue cited among all generations was the lack of access to the internet in the classroom.



## DISCUSSION

The qualitative data revealed that the lack of skills concern was more of a challenge to older cohorts than younger cohorts. However, the current study found no significant difference between age and the level of technology implementation and current instructional practices which is comparable to Summak and Samancioglu (2011). The following factors could be reasons for the lack of ICT integration in the classroom: resistance to change (Fox et al., 2014), anxiety, inability to reconcile ICT with subject matter (Mathipa & Mukhari, 2014). The current study found that most participants found ICT integration time-consuming. Remarkably, the Transition Generation was overly concerned with discipline in the classroom when technology is introduced. In this study, it was clear that the younger cohorts were highly concerned about classroom management; it could be the reason why they are not integrating ICTs in the classroom in spite of the level of knowledge. Further, they appear to be concerned about the level of technology of the learners, which suggests they have a deeper connection with students. These findings are analogous to previous findings (Geeraerts et al., 2016; Polat & Kazak, 2015).

As anticipated, the ICT usage among the oldest cohorts (i.e. Apartheid Generation) is marginally below par as both the Transition Generation (85%) and the Struggle Generation (82.5%) used all digital tools more frequently in their teaching space. It is evident that overall the difference in the number of tools used by the Transition Generation and the Struggle Generation vs the Apartheid Generation is not significantly different. Lei (2009) emphasized the importance of assuming that digital natives have the skills to integrate technology into their classrooms. There is an assumption that younger individuals will tend to use ICT tools in their classrooms more readily. However, in this study, it was found there are few differences with respect to the frequency of usage of ICT tools in the classroom. This finding is similar to Pegler et al. (2010) who found that there is an assumption that Millennial teachers (analogous to the Transition Generation) and will uptake ICTs in more 'comprehensive ways'. They suggest that this may be due to their lack of pedagogical knowledge. This may be true; however, this study finds that the reasons could be due to a lack of access as well.

It was found on average that the Struggle Generation used 68% of e-learning tools more frequently than the Transition Generation. However, the Transition Generation used 87% of Web Services and Tools more frequently than the Struggle Generation. This is comparative to Lei (2009) who found that digital native pre-service teachers spent most of the time on social networking websites and only 10% the time on learning related activities. This study also found that the Transition generation used social media most often. However, the Struggle Generation used both mobile tools and devices more frequently than the Transition Generation, which is unexpected given the assumption that the Transition generation is considered the iGeneration. The Transition Generation appeared to be more familiar with research type tools such as referencing packages and statistical software for qualitative analysis.

Johnston (2013) suggests that in order for educators to resonate with the next generation of learners, it is vital that educators need to use presentation software, social networking, vodcasts and mobile technologies. Additionally material needs to be easily accessible on mobiles, social networking sites, and learning management systems. It appears that all generations are making use of presentation software, however, technologies such as social networking, vodcasts and mobile technologies are used to a lesser extent. Gallardo-Echenique et al. (2015) argued that learners who are digital natives (born 1980 – 1994) are not necessarily equipped to transfer their digital skills to the academic environments despite their digital confidence and skill. The Transition Generation indicated that the learners who are expected to be digital natives in this era lacked the requisite skills. It appears that the Born-Free Generation does not fit the schematic of a 'traditional' Generation Z profile as argued by Gallardo-

Echenique et al. (2015) that there is no specific profile. From the teachers' accounts, these learners do not have the skills to manage technology for educational purposes.

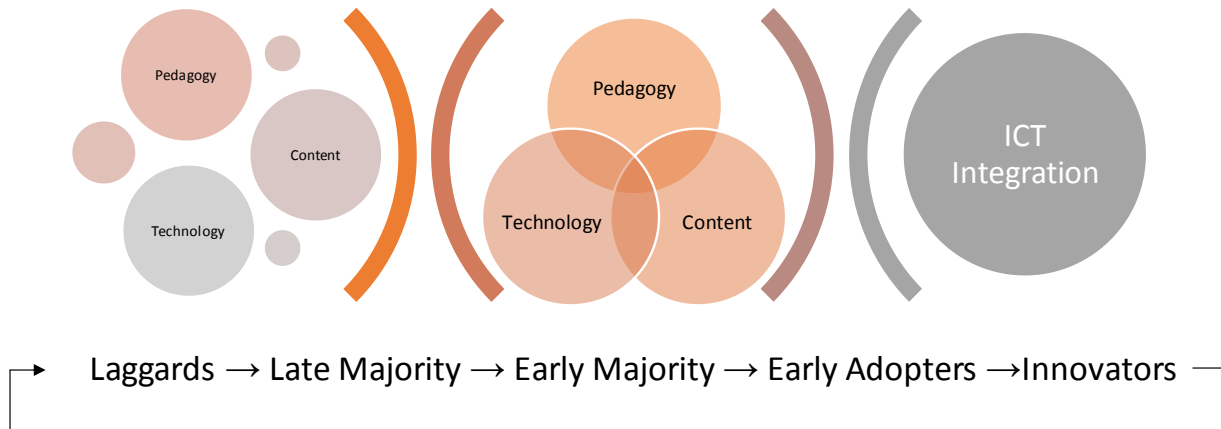
The main contribution of this research highlighted the fact that there is no significant difference between the generations with respect to the frequency of digital tools used in teaching spaces. It is of concern that cohorts of the Transition Generation are not using digital tools in their teaching spaces at a significantly higher level than the Struggle Generation in the South African context. This suggests that this Transition Generation is not making significant gains with technology in their teaching spaces as was expected from this generation who were born into an age where computers and mobile devices are ubiquitous. Similar to Ferrero (2002) it found that using the generation divide was not useful towards a quantitative analysis. The reasons could merely be due to the lack of resources, which was a common theme among the generations. However, a more in-depth qualitative study may be more revealing. There could be other variables at play such as concerns about classroom management, discipline and the lack of understanding how to integrate technology with content. Further research is required to determine why each generation gravitates towards specific types of digital tools in their teaching spaces.

## **IMPLICATIONS FOR THEORY AND PRACTICE**

Pegler et al. (2010) categorically state that generational cohort theory cannot be used as a predictor to determine whether teachers will infuse technology and the author tends to agree with this statement. The generational cohort theory in the context of age cohorts may be an oversimplification of the reality particularly with quantitative studies. Generational theory type studies are more suitable to mixed methods research approaches.

This research suggests that ICT integration is a time-consuming activity, which was a recurring theme. All teachers face the same challenges of balancing the three knowledge bases of technological, pedagogical and content knowledge as advocated by the TPACK model (Pegler et al., 2010). The concept of intergenerational learning will save time by decomposing the task of ICT integration in the classroom. However as the knowledge bases of each generation are not clearly defined, Pegler et al. (2010) suggest that professional development opportunities should consider grouping teachers based on the concept of innovativeness (i.e. innovators, early adopters, early majority, late majority, and laggards). Essentially innovativeness could be used to define a cohort rather than age. 'Innovativeness is the degree to which an individual, or another unit of adoption, is relatively earlier in adopting new ideas than other members of a social system' (Rogers, 2002, p. 990). This concept is based on diffusion of innovations theory as proposed by Rogers (2010, p. 5) who defined diffusion as 'the process by which an innovation is communicated through certain channels over time among the members of a social system'. Hence, this article proposes inter-cohort learning rather than intergenerational learning which could have limitations. Inter-cohort learning occurs where those cohorts with more experience and confidence lead other cohorts (Milante, 2010).

Following on Pegler's argument, the concept of defining cohorts by innovativeness to promote inter-cohort learning to achieve TPACK and consequentially successful ICT integration is shown in Figure 2.



**Figure 2. ICT Integration predicated on Inter-Cohort Learning**

Each level of adopter category can be considered as follows (Rogers, 2002):

- Innovators (venturesome): are risk takers and information seekers (first to try out new ideas).
- Early adopters (respectable): These are opinion leaders and are thus the ones that other potential adopters revere.
- Early majority (deliberate): Adopt new ideas before most others do.
- Late majority (skeptical): Adopt new ideas after most others have.
- Laggards (traditional): The last group to adopt new ideas.

Within the ICT integration predicated on the Inter-Cohort Learning conceptual model, the innovators would be those educators who have already integrated ICTs in their classroom successfully. The early adopters will be those educators close to perfecting the balance between technology, content, and pedagogy. As early adopters are the opinion leaders, they can use their reverence to guide other groups towards successful ICT integration. The model does not preclude the possibility that the other groups (early majority, late majority, or laggards) may have expertise in the other domains (i.e. content, pedagogy, or technology) and they can share their knowledge and ideas to stimulate the innovators.

## CONCLUSION

This article examined the intersection of generational cohorts and ICT competency. Quantitative analysis was applied to a statistical data set collected in the context of a study with teachers (n=113) conducted in South African High Schools in 2016. Findings from this study show that there was no statistically significant difference with respect to ICT competence among different generational cohorts. This observation was also made by Guo, Dobson and Petrina (2008) who found that the idea of a digital divide between native and immigrant users may be misleading and may lead researchers away from considering more relevant aspects such as diversity and competencies. However, the qualitative study

has revealed that each generation may have dissimilar concerns regarding their use of technology in the classroom.

This study considered the extent of the usage of ICTs with the Tshwane district in South African schools at the secondary level. A limitation of the study was that it was restricted to the Tshwane South District. The study involved a sample size of 113 teachers, which may not be large enough to make any generalizations on the teacher population in South Africa. Triangulation of data sources are usually used to validate the results. In this case, the statistical results did not reveal any significant results, however, the qualitative results helped to explain the possible reasons for this. Hence, it is recommended that generational type studies should be done within a mixed research approach.

The future research could involve grouping teachers into innovators, early adopters, early majority, late majority and laggards groups, rather than basing it on the age cohort (Pegler et al., 2010) as this may prove more useful towards professional development.

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