

# ICT Support Environment in Developing Countries: The Multiple Cases of School Teachers in Rural South Africa

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**Abstract:** South African teachers are under pressure due to rising expectations of their content knowledge and digital skills without guaranteed infrastructural or institutional support in using ICTs. The purpose of this study is to find out to what extent ICTs are being used by teachers in rural South African schools and also what support systems, if any, these teachers have. The theoretical lens is that of social network theory to investigate the network teachers use to acquire ICT knowledge and assistance. The data capturing involved a baseline survey where data were collected from 197 rural school teachers in South Africa. The data analysis included descriptive statistics and social network analysis using Kumu as a tool. Our findings reveal that despite the infrastructural challenges and lack of institutional support, rural teachers use technology for teaching and learning. Furthermore, there is evidence that strong social ties with friends and family, faith groups, department of education and businesses that sell or fix ICTs, provide the essential support network. The research provides novel insights into the social networks that sustain the ICT use of rural teachers in South Africa and makes a theoretical contribution through empirical evidence that confirms the strength (degree) of weak ties in explaining sustainable ICT teacher support in rural schools.

**Keywords:** Teachers' ICT support, teachers' social networks, rural ICT support, teacher's digital skills, South Africa rural schools, ICT4D.

## 1. Introduction

The 21<sup>st</sup>-century learners seamlessly integrate the use of ICTs in their social, recreational and academic environments [1]. The extant literature provides evidence of learners academic use of ICTs that assists them with peer learning, offering support to one another and a better understanding of content [2; 3]. The approach to peer learning assists learners in gaining confidence as they know peers are able to assist should they struggle with finding content or using the ICTs [4]. When learners interact with peers using ICTs, their communication involves a process that operates between social and knowledge communication and support.

The 21<sup>st</sup>-century learning environment provides many opportunities for using ICTs in teaching and learning. However, the integration assumes a supporting infrastructure and includes expectations that teachers would be digitally literate and able to use technology [5]. This raises questions about the extent of teachers' use of ICTs in rural environments and their support mechanisms, if any.

The South African government faces resource constraints and therefore teachers are not optimally supported with infrastructure, technology and training opportunities [6; 7]. With the population increases in developing countries, governments have struggled to ensure a favourable learner to teacher ratio [8], the required number of classrooms for teaching and practical [9], teaching and learning materials [10] and skilled teachers [6]. In South Africa, the government has engaged with the private sector to assist in providing adequate support including building and distributing of ICTs in schools [7]. Much of the ICTs are distributed to schools without a focus on how effective they are to teachers, learners and school administration [11].

Teachers are expected to have knowledge and skills to engage with learners [3]. Using different pedagogical approaches, teachers should not only initiate discussion in classrooms but also guide them towards the objective of the topic and ensure learners understand the topic, can comprehend content discussed, and offer examples related to their environments [12]. To achieve all these expectations, teachers are expected to have the latest reading material and offer examples that are current and relevant to the context of the learner [13]. With schools not receiving enough resources from the government, teachers are left to use resources at their disposal and among them is the use of ICTs. The use of ICTs has been shown to assist teachers in enhancing their digital skills by acquiring new content, interacting with colleagues and acquiring training that leads to certificates [14].

There is an expectation that teachers receive assistance from the government in relation to the use of ICTs and acquiring necessary skills [8]. However, as discussed earlier, governments have limited resources and thus are not able to offer the support required by teachers. The situation is dire in rural areas where the shortage of teachers and teaching and learning material is common [15]. To summarise, despite the challenges that teachers face, learners, even in rural areas, are techno-savvy and demand more academic content from their teachers. Thus, teachers are not only expected to have digital skills but also to effectively use technology to enhance learning (TLE) to support and enhance learners understanding. This tension between the potential ICTs have for supporting education, lack of sufficient digital support for teachers and rising digital expectations form learners provides the rationale for this study. We engage with the questions, *to what extent ICTs are being used by teachers in rural schools and what support systems do these teachers use.*

The next section presents a content review of teachers' use of ICTs, teachers support structures in using ICTs and the theoretical lens used in the study. The methodology section follows next with information on the scientific approach to data collection, analysis and presentation. Findings are presented in the fourth section with the guidance of social network theory and the section is followed by the discussion where these findings are related to other research, we revisit the research question and present research limitations. The final section presents the research contribution and areas for future research.

## **2. Literature Review**

Teachers' use of ICTs has been documented by researchers in relation to electronic learning and mobile learning [8; 10; 16; 17]. Those researches have argued that teachers in rural areas of developing countries use ICTs as much as their colleagues in urban areas. In the past, much of the discussion on teachers use of ICTs was to prepare for classroom interactions and administrative tasks [18]. Recently, the demand has increased to incorporate teaching and learning using ICTs [11]. While in the past focus was placed on using computers and projectors [19], the recent move discusses the use of tablets, laptops and smartboards [8].

Each ICT comes with its own unique challenges that teachers have to master and be equipped to troubleshoot [5]. Such technical skills are beyond teacher's capabilities as teachers training colleges and some universities are not sufficiently equipped with ICTs [20]

and therefore do not provide such knowledge to teachers. Teachers are thus equipped with pedagogical skills necessary for teaching relevant subjects (modules) in schools. The governments in developing countries have tried to address some of the challenges in schools and partnered with the private sector to provide ICTs [21]. The presence of the partnership has assisted with acquiring ICTs that are distributed to teachers with training [14] but in some cases abandoned when projects complete. It is imperative to thus assess the support structures that teachers have.

The support structure that a teacher receives depends on the environment that surrounds them. Teachers in developing countries are treated with utmost respect especially in rural areas [22]. These teachers are looked up to as the source of knowledge to learners who will uplift the economic condition of the community. Thus, teachers in rural areas receive ICT support from the community [18] and this includes their personal social networks (not to be confused with ICT social networks such as social media and blogs). The social network ranges from family members such as daughters and sons to non-government organizations (NGOs) operating in the community [7].

Social network theory (SNT) is a theory that provides an explanation of how individual personal networks are intertwined in interpersonal relationships [23]. SNT views social relationships in terms of nodes and ties where nodes represent the individual actors within the networks while the ties represent the relationships between the actors [24; 25]. A social network can be depicted in terms of a map of all of the relevant nodes (points) and the ties (lines between the points) being studied. Social network theory offers an understanding of the teachers' support structure as it analyses each individual as a node and their relationships as links [26]. Each teacher is thus taken to be a node that is related to people in the local community and beyond [23]. Different levels of relationships are identified [26]. The ties are strong if a teacher is connected via close relationships to other people and weak if the relationships are weaker in nature [23]. Social network theory introduces the notion that the attributes of individuals are less important than their relationships and ties with other actors within the network [24]. Further, the relationships offer insight on how one can traverse the nodes to acquire needed information within the social network. The latter also highlights the strength (also referred to as degree of a node) of weak ties, whereby people benefit from having many weaker ties, compared to a few strong ties [24; 25]. At the same token, bridging links assist to connect strong and weak ties in a community [27].

In summary, it is evident that teachers have adopted ICTs and there is a demand for addressing the challenges that ICTs introduce. The literature suggests that teachers address these challenges using the support structures they have in their environment to understand and use the ICTs effectively. The literature provides evidence that social networks assist teachers with ICT knowledge and skills, but the structure of those networks and the strength of the ties have not been investigated for rural school teachers in South Africa. Therefore, this research departs from the premise that social networking provides support to teachers in using ICT and probes into the extent of ICT usage and the structure of the social networks in the context of ICT usage by rural teachers in South Africa.

### **3. Methodology**

The research uses interpretive philosophy to understand teachers' ICT support environment in rural areas of developing countries. Interpretive philosophy affords the relative understanding of ICT support system as built by the community and can only be understood from the community point of view [27; 28]. The philosophy also offers acceptance of subjectivity in that multiple realities are valid and relevant to representing teachers' experience.

A case study is used as a methodology to investigate teachers use of ICT and the presence of their support environment as a contemporary phenomenon in developing countries [29; 30]. Specifically, we apply a multiple case study approach that offers a rich understanding of how the context including how interactions occur and why teachers support system in multiple schools is strong or weak [30; 31]. The research used questionnaires with open and close-ended questions that were distributed to 197 teachers in 24 schools within seven provinces in South Africa. The questionnaires intended to explore issues around ICTs and who supports teachers in rural environments. The seven provinces that questionnaires were distributed (the number of schools in brackets) include Northern Cape Province (7), North West Province (3), Gauteng (3), Kwa Zulu Natal (3), Free State (3), Limpopo (3) and Eastern Cape (2). Each school provided between five and nine teachers that completed the questionnaires.

Schools in these rural areas are categorized as Quintile 1 and 2 which refer to the predominant households served by schools as being in lowest household income groups in SA. These are the poorest schools as identified by the SA government and is compensated for by receiving “seven times more subsidy than advantaged schools in Quintile 5” [33, p. 84].

The Meraka Institute of the Council for Scientific and Industrial Research (CSIR) was contacted by the Department of Rural Development and Land Reform (DRDLR) to operationalise a project titled Information and Communications for Education (ICT4E) at rural schools in South Africa. Purposive sampling was used since the schools were handpicked by the DRDLR. The University of Free State (UFS) offered training following the success of the ICT4RED (see [7; 14]) project where tablets were provided to teachers for sustainable teaching. DRDLR intended to support schools in the AgriPark project. Results from a pilot study conducted in the Western Cape were used to review the curriculum used for ICT4RED and later for ICT4E to ensure the sustainability of the projects.

The unit of observation is teachers as individuals that completed the self-administered questionnaires. The units of analysis are teachers as individuals and interactions with the community and government levels, including the inter-connections which emerged among the teachers and the community members. Quantitative data were analysed using descriptive statistics to show the frequency of teachers who have adopted ICTs in rural schools. Qualitative data from open-ended questions were analysed using social network analysis and presented as social network diagrams by means of Kumu as a tool. The use of quantitative methods in interpretive studies is discussed in research by [34].

Ethical clearance was acquired from the CSIR research ethics committee and principals of the schools where data was collected. Teachers were overtly informed of ethical guidelines in relation to asking for permission to collect data, confidentiality guidelines and reporting of the findings [33; 34]. Teachers were also informed of the objectives of the research before completing the self-administered questionnaires. The Kumu maps in the findings sections are intentionally blurred to ensure no names are identifiable as required by ethical considerations. Teachers’ names and those of their ICT support persons are presented using a proxy.

## **4. Findings**

Results discussed in this section are from data collected in rural schools from seven provinces in South Africa. The following information on demographic data was captured, namely, age, gender and language. In addition, data on the adoption of computers at the schools and adoption of tablets were collected.

Age: The youngest teacher is 22 years and the oldest is 64 years old. The majority of the teachers are 46 to 50 years old.

Gender: There are 129 female teachers and 68 male teachers.

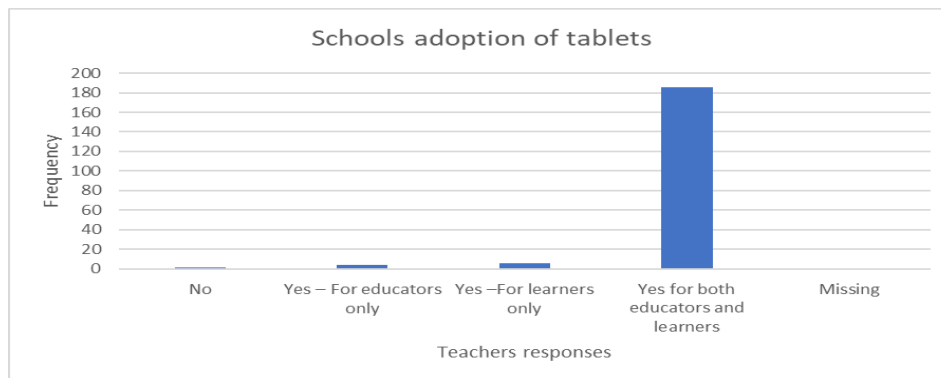
Language: Forty-two teachers speak Setswana which is one of the languages spoken in Northern Cape province where data was collected from seven schools as shown in Table 1. The second most spoken language was Afrikaans, spoken by 40 teachers. The total users of home languages surpass 197 (the total number of respondents) this is due to the fact that some teachers speak more than one home language. Such a phenomenon is common in rural areas of South Africa.

Criteria	Frequency	Percentage
<b>Home language</b>		
Afrikaans	40	18%
IsiXhosa	32	14%
Sesotho	14	6%
Setswana	42	19%
SiSwati	1	0%
English	4	2%
Sepedi	27	12%
Xitsonga	2	1%
IsiZulu	30	13%
Sepedi	27	12%
IsiNdebele	1	0%
Other	3	1%
<b>Total</b>	<b>223</b>	<b>100%</b>

Table 1: Teachers Home Language in the Northern Cape Provinces

Adoption of tablets: Figure 1 presents information in relation to the adoption of tablets, with 186 teachers stating that the schools have tablets for both learners and teachers. Six teachers stated that tablets are available for learners only, while four teachers stated that tablets are available for teachers only, and only one teacher stated that there are no tablets at the school.

Figure 1: Schools Adoption of Tablets



It is ironic that one teacher would state there are no tablets at the school while the rest of the teachers from the same school said tablets exist at the school and are used by teachers and learners alike.

The extent of teachers' use of ICTs: In relation to personal ownership of technology at home as displayed in Table 2, 121 teachers confirmed owning a computer or laptop, 133 teachers said they owned tablets or other digital devices, 55 teachers had access to the Internet and 67 teachers had printers. Teachers' adoption of ICTs at home is not mutually exclusive. A single teacher can own a tablet computer, have access to the Internet and a printer. Thus the total of the frequency surpasses 197 respondents as some teachers own more than one ICT devices.

ICTs adopted at home (select more than one)	
	Frequency
Tablet Computer or another digital device	133
Computer or Laptop	121
Internet	55
Printer	67

Table 2: ICTs Adopted by Teachers at Home

The use of tablets or other digital services seems to be prevalent among teachers in rural schools than the use of computers or laptops. Teachers who have adopted such technologies become confident in using them not only in personal life but also to assist colleagues. Based on the knowledge and skills acquired from personal use of ICTs (as shown in Table 2), teachers apply what was learnt at home in school environments for teaching and learning using tablets available at school as presented in Figure 1.

Using these ICTs, teachers communicate with colleagues, family and other members in the society building on a social network that affords them knowledge acquisition which is presented based on strong and weak ties. These strong and weak ties are not only representation of the nodes and the relationships but also that of a social network as explained by social network theory. Further, the inter-relationships that teachers have with government officials, colleagues, stores and businesses strengthen the explanation of the social network theory.

#### 4.1 Strong Ties

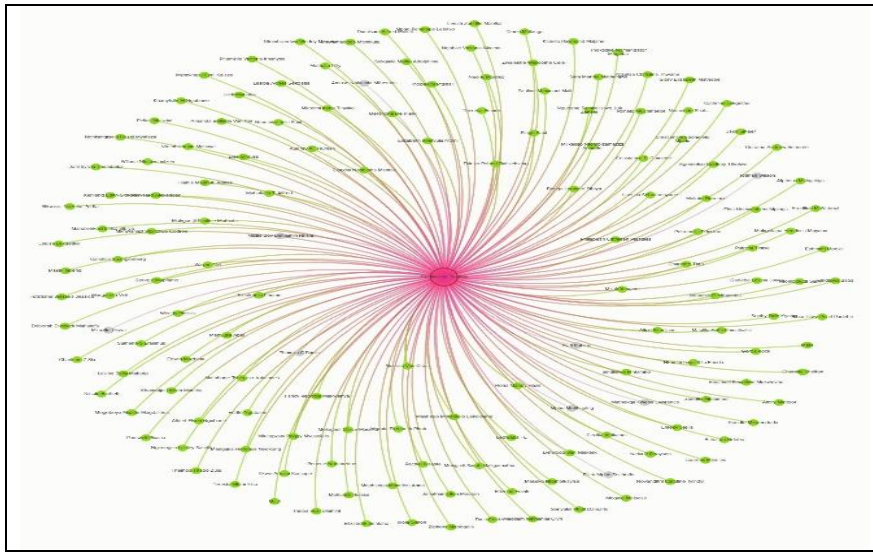
Frequent communications (most probably on a day to day basis) are represented as strong ties. Figure 2 shows the many ties that exist between teachers and their respective friends and family node. Different from how SNT usually shows the individuals' ties to other individuals, we represent *friends and family* as a group and the social network diagram is drawn such that every node (shown by green bubbles and representing teachers) is connected to the group (displayed in pink). The interpretation is that the strong connections are shown by the presence of many ties with the friends and family group. We present only the *family and friends* Kumu map to depict the strong ties, the maps for faith groups, government education and businesses selling/fixing ICT are similar to the family and friends map as discussed below.

Family and friends: Figure 2 shows the relationship between teachers and their friends and families. Teachers use their children (sons or daughters), siblings, cousins, nieces and nephews and family friends to acquire ICT support. Almost all teachers identified receiving support on ICT issues from family and friends.

Faith groups: Teachers identified that they request support on ICT issues from fellow faith members such as pastors, choir groups and bible study participants.



Figure 2: Teachers Connecting to Friends and Family for ICT Support



Government education: Teachers within the school and in surrounding schools were labelled as government education staff. We identified that teachers acquire assistance from colleagues within the school and in other schools in the surrounding areas. Also, other employees in the department of education assisted teachers with ICT issues. Most notably was assistance from ICT employees in the department of education (including circuit managers), adult basic education and training (ABET), technical colleges (Motheo TVET College) and university students (University of Pretoria, North-West University, University of Fort Hare and Central University of Technology). It has to be noted that some of these universities are in a different province from the province in which teachers identified them as a source of support.

Businesses selling/repairing ICT: Teachers listed mobile operating companies such as MTN and Vodacom as part of their ICT support in rural areas. Other companies included Pep stores, Vanto Technologies and Cell Pro Cellular. Teachers also mentioned shop owners/staff and individuals that offer support with ICT issues.

#### 4.2 Weak Ties

The less frequent communications (i.e. communication happens once in a while) are represented as weak-ties. Figure 3 shows the few ties between teachers and their tribal authorities' nodes. A weak-tie is a result of teachers being acquaintances to colleagues represented in the groups. We present here a Kumu map for teachers connecting to tribal authorities for ICT sport. The Kumu maps for government health, NGOs, sports clubs, support and cultural groups are similar to that of tribal authorities with fewer nodes connecting to the group and showing weak ties. The implications of weak ties are that they assist to bind strong ties with support and resources that individuals cannot provide and require collaborative efforts to access them.

Government health: Teachers identified that individuals within the Department of Health provide them with support on ICT issues. Among the individuals are the admin clerks and nurses in health facilities that teachers visit. Teachers also identified clinics and general practitioners (GPs) offices as places that they can acquire ICT support.

NGOs: Teachers identified non-government organizations (NGOs) that have assisted them with ICT issues. Among the NGOs are the China disabled people organization, Kingdom First Ministry and Love Life. The Kingdom First Ministry is a faith group but teachers who

listed it as an NGO are not members of the faith group and their only relationship to it is through the community outreach that the organization does.

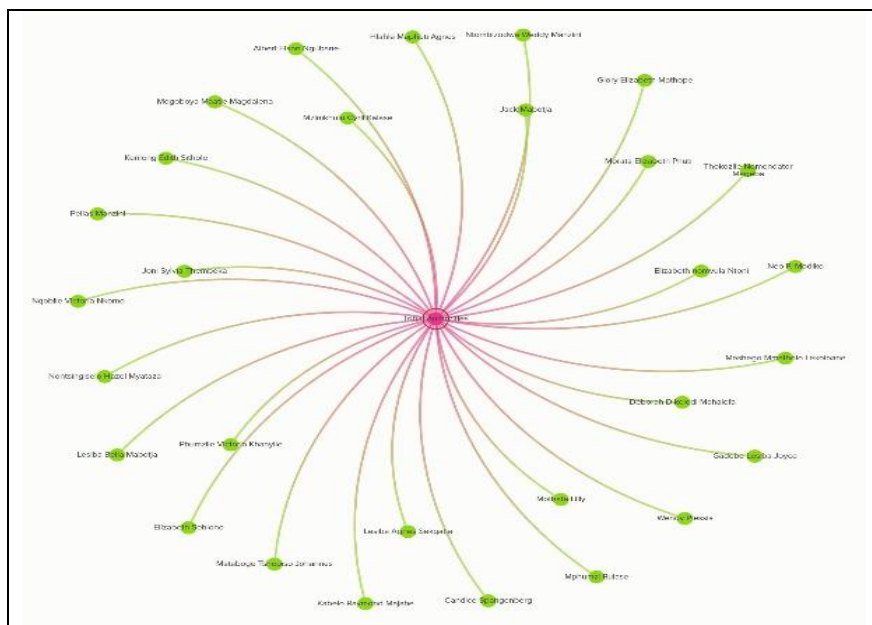
**Sports clubs:** Teachers who engage with sporting activities identified soccer clubs (Bloemfontein Celtics Football Club), rugby unions (South Africa Rugby Union), cricket clubs (Papelelo cricket club) and sports centres (Royal Bafokeng Sports) as places where they acquire assistance with ICT issues. During their sporting interactions, not only are they strengthening their health by engaging with sports, but also exchanging ICT skills and knowledge with other sports attendees.

**Support groups:** Due to the presence of diversity in teachers, having youth and elderly, it was identified that places like youth centres, cancer support group, social clubs, home care facilities and individuals from the Department of Social Development offer teachers with support on ICT issues when in need.

**Cultural groups:** Teachers have weak ties to the cultural groups as most of them referred to a previous student who engages with cultural activities as the person that assists them with ICT issues. Further, about six people were identified to offer assistance during cultural interactions.

**Tribal authorities:** The tribal office secretary, the clerk and four tribal leaders offer ICT support to teachers in rural areas. Among the tribal leaders are those from the Royal Bafokeng Nation which is in Gauteng.

Figure 3: Teachers Connecting to Tribal Authorities for ICT Support

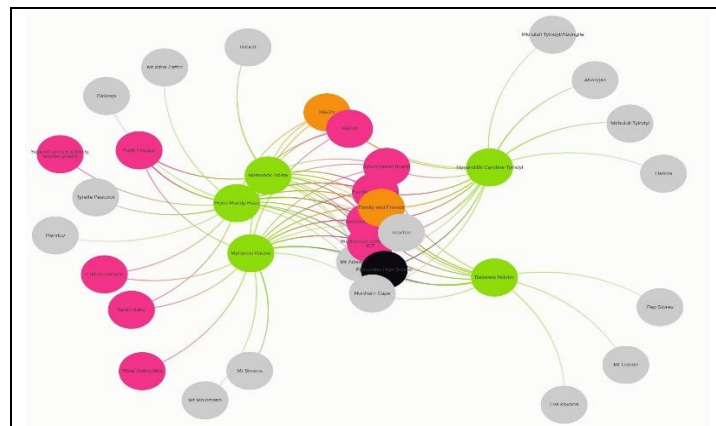


#### 4.3 Presence of Teachers Inter-Networks (Bridging Ties)

Figure 4 presents the inter-networks (bridging ties) that exist in the rural community. The figure shows the networks teachers have. In this case, we used one individual who is a department of education employee (presented on section 4.1 as government education) to study his connection to teachers and other nodes that are indirectly connected to him. Our findings show that the employee (shown as a black node) is directly connected to five teachers (represented in green nodes) who in turn relate to other nodes (both individuals and groups). The teachers that socially relate to the government employee and seek ICT support also relate to other sources of support such as health workers and owners of mobile stores. Thus an individual has both strong and weak ties that operate as bridging ties.



Figure 4: Interpersonal Relationships



Despite the strong and weak ties teachers have according to Figure 4, the map also shows a connection to people from other schools and provinces which means colleagues assist one another. Furthermore, the map shows the support teachers receive from store owners and family members are intertwined with support by colleagues, thus extending the circle of assistance to both strong and weak ties. It became evident that there are patterns of one individual assisting many teachers with ICT issues, as illustrated in the case of an individual assisting five teachers and hence having a diverse network of teachers he assists in the local community and beyond. This is an example of how weak ties between the teachers and the government officials sustain the ICT support infrastructure.

## 5. Discussion

In response to the research questions, namely *to what extent ICTs are being used by teachers in rural schools and what support systems do these teachers use?* Our results provide evidence of regular ICT use which involves the teachers' own tablets, smartphones, laptops, computers, printers and access to the Internet. This confirms the earlier findings of prolific and varied ICTs usage by teachers use in rural areas as reported by [37] in their research on K-12 teachers and the use of tablet-PCs. Using these ICTs, teachers are able to acquire academic content that enhances their digital skills and strengthens confidence in using ICTs.

In relation to support systems that teachers in rural areas have, our findings illustrate that strong ties in acquiring support for ICT issues emerge from family and friends, faith groups, government education and businesses selling and fixing ICTs in the community. The strong ties are explained by [23] as those that engage frequently, either physically or in using ICTs and represent family and friends. The strong ties built on faith can come together to support one another by building a school and engaging with the government to acquire teachers which implicitly assist one another with ICT issues. In a study on national ICT policies it was identified that schools work in close partnership with businesses which offers, among other services, on-the-job training [39]. The presence of weak ties is evident from the relationship of teachers' nodes to government health, NGOs, sports clubs, support groups, cultural groups and tribal authorities. In the case of teenagers behaviour it was found that they prefer weak ties in sports groups where they can send a message to the group and do not anticipate frequent communication from the group members [23]. The low frequency of communication may also therefore assist to identify weak-ties that teachers have to colleagues and groups.

## 6. Conclusion

Factors like the ubiquity of ICT, student's increasing digital skills and the shortage of teaching and learning material in rural areas has created expectations of using ICTs in rural education. On the other hand, government support in creating infrastructure and providing

digital skills training is lacking. This could lead to tension between teachers' expected ICT usages for teaching and learning and the actual use since teachers have to acquire digital skills in order to realise the potential of ICT for teaching and learning.

*In relation to our question on the extent to which ICTs are being used by teachers in rural schools*, our findings show that teachers have adopted tablets and other digital devices that they use for personal and academic reasons. Regarding the *support systems rural teachers use*, our findings further show that teachers' social networks function through both strong and weak ties to acquire support on ICT related issues.

The research offers a contribution to the body of knowledge on e-learning and rural education through the discovery of strong and weak social networks that provide important insights in understanding how teachers in rural areas acquire support on ICT issues and how ICTs are adopted in conditions of resource constraint. The research also makes a contribution by providing empirical evidence that social network theory and especially the roles of strong and weak ties are applicable to explaining ICT teacher support in rural schools.

The role of NGOs, cultural groups, sports clubs and tribal authorities in rural areas of South Africa are not strong as we anticipated and challenged our assumptions. South Africa's tourism bodies market a rich cultural heritage and the important role of tribal authorities in tourism, while in our research these social structures do not feature prominently in the domain of personal ICT support. The roles of NGOs and sports clubs are also limited to weak ties in rural areas while these are wide spread in towns. There is a need for NGOs that focus on ICT adoption and use in South Africa to spread the knowledge to rural areas and especially assist cultural and tribal authorities in understanding the role of ICTs in schools.

Future research could engage with the different types of support beyond the interpersonal and especially involve government and cultural groups through the use of interviews to acquire insight on the viewpoints regarding how ICT support should be offered.

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