The ICT development needs of South African Science and Mathematics Teachers

by

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DECLARATION OF ORIGINALITY

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Special thanks go to my fiancée, Mbali Gumede who offered support and for the sacrifices she made for me to succeed.

ABSTRACT

Teachers need to develop 21st Century skills and be competent users of ICT to integrate it successfully in their everyday instruction and learning activities. The goal of this Secondary Data Analysis (SDA) study is to determine the proportion of South African Science and Mathematics teachers who experience a lack of ICT-related skills and pedagogical skills related to the integration of ICT in instruction and learning as an obstacle. Furthermore it has been investigated whether these teachers are willing to be trained. This study is a response to the distressing outcome of the The Second International Technology in Education Study (SITES 2006), an international survey that was conducted by the International Association for the Evaluation of Educational Achievement (IEA), indicating that South Africa has the lowest ICT integration among the SITES 2006 participating countries (16% for Science and 18% for Mathematics).

The current study followed a basic SDA of the SITES 2006 dataset relating to South African Science and Mathematics teachers and adopted an integrated qualitative-quantitative approach. The results indicate that there is a great need for South African Science and Mathematics teachers to attend professional development activities since there are many teachers who lack ICT-related skills (55%) and pedagogical skills related to the integration of ICT in instruction and learning (62%). The teachers who experience a lack of ICT-related skills and pedagogical skills are willing to be trained (88% and 93% respectively). These results imply that the challenge now rests with the government of South Africa to make sure that professional development activities that are both relevant and subject-specific are offered on a regular basis. The Government needs to devise strategies to promote professional development for the improvement of ICT integration into South African classrooms.

Key words

21st Century skills; Secondary Data Analysis; ICT-related skills; pedagogical skills; ICT integration; instruction and learning; SITES 2006; SITES dataset; qualitative-quantitative approach; professional development.

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LIST OF TERMINOLOGY

21st Century skills	These are specific skills learners need to master in order for them to survive in the 21st Century and beyond (Partnership for 21st Century skills, 2009).
ICT integration	The conscious use of ICT-related technologies to inform our daily activities, and to improve our practice in teaching and learning (Blignaut, Els & Howie, 2010b.) ICT integration is also aimed at cultivating 21st Century skills in learners (*ibid*).
ICT skills	Proficiency in using the various Information Communication Technology related devices in searching, accessing, synthesising and presenting the various forms of information (Partnership for 21st Century skills, 2009).
Nordic countries	This is a term used to refer collectively to five countries that lie in the northern part of Europe. These countries are Denmark, Finland, Iceland, Norway and Sweden (Wikipedia, n.d.).
Pedagogical skills	The various skills teachers use in their practice to teach. These include an array of teaching styles and methods teachers use to present information to their learners (Partnership for 21st Century skills, 2009).
Professional development	A formal way through which professionals acquire skills and knowledge to improve their practice continuously or to be more effective in their practice. This can be for both personal development and career advancement (Weingarten, Cortese & Johnson, 2008).

LIST OF ACRONYMS

DOE	Department of Education
GPS	Global Positioning System
HIMA	High percentage of frequently ICT-using Mathematics
ICT	Information Communication Technology
IEA	International Association for the Evaluation of Educational Achievement
LOMA	Low percentage of frequently ICT-using Mathematics
ODC	Online Data Collection
PDA	Personal Digital Assistant
SITES	Second Information Technology in Education Study
SPSS	Statistical Package for Social Science
UNESCO	United Nations Educational, Scientific and Cultural Organization

LIST OF ADDENDA

Due to the length of the Addenda, they have been burnt on a CD-ROM available at the back of the dissertation.

Chapter 1 – Research problem and topic

1.1 Introduction

The need for teachers to develop 21st Century skills cannot be over-emphasised. Teachers need to be competent users of ICT in order to integrate ICT successfully into everyday teaching and learning. The partnership for 21st Century skills identifies the following ICT-related skills that teachers ought to possess in order to be effective: teachers need to have the necessary skills to access the information that is rapidly increasing since we are living in an information society (Partnership for 21stCentury skills, 2009). To do so they need to "use technology as a tool to research, organize, evaluate and communicate information" (*ibid*). The partnership for 21st Century skills also stresses the importance of using technology tools to create a deep and meaningful understanding in learners (*ibid*). To achieve this teachers need to have a mastery of content knowledge; use a range of ICT-related teaching strategies; make the learning experience of learners meaningful by using real-world examples; use a balance of technology-enhanced formative and summative assessments; explicitly teach learners 21st Century skills, and allow the learners to apply what they have learnt in real-life situations and to appreciate the role played by ICT in our modern society (*ibid*).

In spite of these expectations that teachers are expected to meet, South African Science and Mathematics teachers scored disappointingly low in terms of ICT and pedagogical skills in the SITES 2006 survey. Fifty seven percent (57%) of both Science and Mathematics teachers reported that they lack general ICT skills (Ainley, Eveleigh, Freeman & O'Malley, 2010). Consequently South Africa has the lowest integration of ICT in Science and Mathematics classrooms (16% and 18% respectively) of the SITES 2006 participating countries (*ibid*). There is therefore a dire need for South African Science and Mathematics teachers to attend ICT professional development courses in order to improve ICT skills to improve ICT integration in instruction and learning.

This chapter provides a brief background to the research problem, describes the conceptual background, states the problem, gives the purpose of the study and research questions, states the significance of the study and mentions research assumptions, limitations and delimitations.

1.2 Background to the problem

South Africa, like many developing countries, faces several challenges regarding the integration of ICT in the instruction and learning process. South Africa scored disappointingly low in almost all the indicators of the SITES survey (Ainley, Eveleigh, Freeman & O'Malley, 2010). For example, South African Science and Mathematics teachers who reported to be using ICT in their instruction-leaning activities amounted to 16% and 18% respectively (*ibid*).

Several authors (Mofokeng & Mji, 2010; Ainley et al., 2010; Blignaut, Hinostroza, Els & Brun, 2010a) point to inadequate ICT infrastructure and lack of ICT competence in both teachers and learners as some of the major obstacles impeding the successful integration of ICT in the instruction and learning process. Most South African Science and Mathematics teachers that partook in the SITES 2006 project attribute the low frequency of ICT use to inadequate infrastructure, limited computer access, the lack of technical and pedagogical skills, low professional development opportunities and the lack of ICT skills that are reflected in low self-reported confidence in using ICT for pedagogical purposes (Ainley et al., 2010).

Table 1 shows that South African Science and Mathematics teachers experience many obstacles relating to the integration of ICT in instruction and learning. Inadequate ICT infrastructure has been identified by 62% Science and 64% Mathematics teachers as an obstacle to the integration of ICT. Moreover, a lack of general ICT skills (54% for Science and 57% for Mathematics teachers) and a lack of pedagogical skills (62% and 63% for Science and Mathematics teachers respectively) have been identified as another major obstacle. Science (39%) and Mathematics (40%) teachers have reported that they are not confident to accomplish various ICT tasks. Finally 51% of both Science and Mathematics teachers reported that they do not have access to a computer outside the school.

Table 1: Percentages of South African Grade 8 Science and Mathematics teachers reporting various factors as obstacles to using ICT

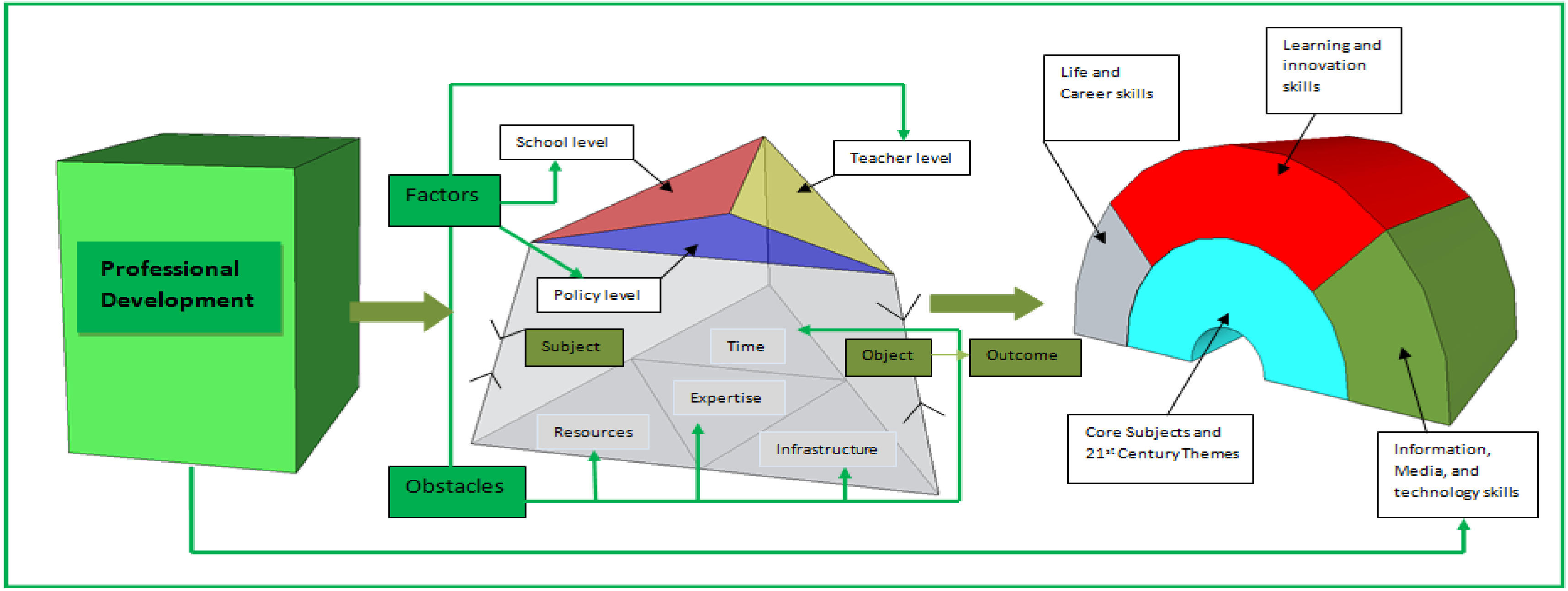
	Lack of infrastructure	Lack of ICT general skills	Lack of ICT pedagogy skills	Lack of Self-confidence	No access to ICT out of school context
Science teachers	62%	54%	62%	39%	51%
Mathematics teachers	64%	57%	63%	40%	51%

Adapted from Ainley et al. (2010)

1.3 Theoretical framework

Professional development is aimed at developing 21st Century skills that are outlined in the framework for 21st Century learning. There are several factors that affect professional development and obstacles that hinder the success of professional development. The theoretical framework shown in Figure 1 forms the basis and the point of reference for this study. As shown in Figure 1, the main outcome of professional development is the development of 21st Century skills, but standing in the way of professional development are the factors affecting it and the obstacles hindering its being achieved. This framework also delineates the scope of the study in that it highlights the 21st Century skills teachers ought to possess, describes the factors that affect professional development and highlights the obstacles that hinder professional development.

Figure 1: Theoretical framework



However, the main focus of this secondary data analysis (SDA) research is on professional development, and on the obstacles that hinder professional development, in particular a lack of expertise which is the focal point of the research. From all the skills outlined in the framework for 21st Century learning (Partnership for 21st Century skills, 2009), this study concentrates only on Information, Media and Technology skills, that isICT literacy.

1.3.1 Obstacles hindering professional development

Among the obstacles identified (lack of expertise, ICT infrastructure, digital resources and time) this study focuses on expertise only, which relates to whether or not teachers possess specific ICT skills (general and pedagogic). This is because in many instances expertise is often overlooked. Most of the time governments concentrate their efforts on providing more infrastructure and digital resources in their quest to improve the integration of ICT in instruction and learning.

1.3.2 Factors affecting professional development

1.3.2.1 System level factors

System level factors relate to national policies and guidelines that are aimed at developing teachers' ICT competence. For example, the Department of Education White Paper on e-Education stipulates that "every teacher, manager and administrator in General and Further Education and Training must have the knowledge, skills and support they need to integrate ICTs in teaching and learning" (Department of Education, 2004, p. 25).

1.3.2.2 School level factors

School level factors relate to the contexts that exist in schools where teachers work. These contexts may either encourage or inhibit teachers to participate in professional development activities. In the review of related literature, a high positive correlation was found between the principals' vision in using ICT to promote lifelong learning and teachers' vision to promote lifelong learning with a Pearson correlation of 0,647 ($p < 0{,}01$) (Law, Lee & Chan, 2010).

1.4 Statement of the problem

Ainley et al. (2010) contend that the integration of ICT in instruction and learning is enhanced when teachers are competent users of ICT, when they have attended ICT-related professional training courses and when there is ICT infrastructure, ICT access and a range of digital learning resources. Furthermore, research shows that there is a positive correlation between teacher competence in using ICT and the integration of ICT in teaching ($r = 0{,}71$ for Science and $r = 0{,}58$ for Mathematics) (*ibid*). Unfortunately in South Africa 57% of both Science and Mathematics teachers reported that they lack general ICT skills (*ibid*). Consequently, South Africa has the lowest integration of ICT in Science and Mathematics classrooms (16% and 18% respectively) of the SITES 2006 participating countries (*ibid*).

Drent and Meelissen (2008) identify personal entrepreneurship as an important factor in the development of ICT skills in teachers. Personal entrepreneurship inspires teachers to take ownership of their professional development and improves their willingness to keep on seeking new ways of developing their ICT competency through formal and informal training (*ibid*). It is therefore important to explore not only the Science and Mathematics teachers' ICT training needs but also their willingness to be trained. This will help to determine the teachers' attitudes towards ICT integration in instruction and learning, and to suggest ways that can be used to develop personal entrepreneurship and positive attitudes towards the use of ICT in schools. These factors (personal entrepreneurship, positive attitudes towards ICT and teachers' willingness to be trained) are often overlooked; yet they are very important. Governments in many cases concentrate on the provision of ICT infrastructure and access to ICT only.

Professional development needs can be determined in many different ways. Kurtner, Sherman, Tibbetts and Condelli (1997) list multi-purpose strategies that can be used to determine teachers' reactions, knowledge and skills, and behaviour by using questionnaires, interviews and focus groups. In the SITES 2006 survey professional development needs were assessed using a questionnaire in which teachers were asked whether or not they possessed specific ICT skills.

1.5 Purpose of the study

The purpose of the study is to explore the training needs of South African Science and Mathematics teachers relating to ICT and their willingness to be trained.

1.6 Research questions

1.6.1 Research question 1

The following research questions relate to the South African Science and Mathematics teachers' general ICT skills and their willingness to be trained:

a) What proportion of South African Science and Mathematics teachers requires a professional development course in Internet use, general applications and advanced courses for applications?
b) What percentage of those South African Science and Mathematics teachers who require a professional development course in Internet use, general applications and advanced courses for applications are willing to be trained?

1.6.2 Research question 2

The following research questions relate to the South African Science and Mathematics teachers' pedagogical skills related to the integration of ICT in instruction and learning, and their willingness to be trained:

a) What proportion of South African Science and Mathematics teachers require a professional development course in pedagogical issues related to integrating ICT into instruction and learning?

b) What proportion of those South African Science and Mathematics teachers who require a professional development course in pedagogical issues related to integrating ICT into instruction and learning are willing to be trained?

1.7 Significance of the study

Previous studies conducted using the SITES 2006 dataset have concentrated their efforts on the factors affecting the implementation of ICT (system level, school level, teacher level and student level factors) (Pelgrum & Voogt, 2009). These factors have been discussed to explain how they facilitate or hinder the use of ICT. Another important point discussed in previous studies is the pedagogical use of ICT in the teaching of Science and Mathematics (Law, 2009). The pedagogical use of ICT has been discussed in line with the factors affecting the implementation of ICT (*ibid*). For instance, policy has an impact on the pedagogical use of ICT (Bryderup, Larson & Trentel, 2008; Ottestad, 2010; Law, Lee & Chan, 2010).

However, no studies have been conducted to determine the training needs of South African Science and Mathematics teachers relating to the implementation of ICT and their willingness to be trained. It is this void in literature that this study seeks to address. One of the so-called buzz words of the 21st Century is "the development of 21st Century skills" (Partnership for 21st Century skills, 2009), and this can be achieved through ensuring that teachers participate in professional development activities. Moreover, one of the key roles of teachers stated in the Norms and Standards, and Standards for Educators is that they should assume the role of being a "scholar, researcher and lifelong learner" (Department of Education, 2000). This implies that teachers should always be involved in continuous professional development activities to be part of the information society. This research should make valuable recommendations on the stance the South African government needs to take with regard to policies aimed at addressing the training needs of South African Science and Mathematics teachers.

1.8 Assumptions

The study assumes that the data contained in the in the IEA data repository is accurate, reliable and devoid of errors. This assumption is based on the fact that the IEA has more than 50 years' experience in conducting research in education. Moreover, SITES 2006 is the fourth project in ICT-related surveys, which implies that its researchers have a vast experience in conducting surveys and as such their data is trustworthy.

1.9 Limitations

The major limitation of using secondary data analysis is "inherent in its nature" because the data was collected to address different research questions, and as such specific information that may be crucial to one's research may not be there (Boslaugh, 2007, p. 4). Another problem relates to the way in which the data has been categorised; for instance, it may be in categories rather than continuous variables (*ibid*). Some information collected may not be made available to the secondary researcher for reasons of confidentiality (*ibid*). Another major problem is that "of not having been there", which has serious implications when it comes to the interpretation of the data (Heaton, 2008, p. 40)

1.10 Delimitations

Professional development should be geared towards the development of 21st Century skills. However, from all the skills outlined in the framework for 21st Century learning (Partnership for 21st Century skills, 2009), this study concentrates on Information, Media and Technology skills, in particular, ICT literacy only.

Chapter 2 – Literature review

2.1 Introduction

This section reviews literature that is pertinent to this study. Since the research is based on a secondary analysis of the SITES 2006 data, the first part of the literature review provides a brief overview of secondary data analysis. The second part of the literature review relates to professional development since the main aim of the study underscores the importance of professional development. The general ICT skills and pedagogical ICT skills that teachers need to possess are also briefly discussed. The final part of the literature review explores several articles published in both local and international journals relating to the SITES 2006 studies. The purpose of this review is to identify themes that have emerged in previous studies that are relevant to this study, and to identify the voids that exist in the literature reviewed.

2.2 Secondary Data Analysis

When conducting secondary data analysis a researcher may refine the research questions, hypothesis and research methods that were used in the original research or may employ totally different research methods (Windle, 2010). Basically secondary data analysis involves analysing data that was collected by other people for a different primary purpose (Smith, Ayanian, Convinsky, Landon, McCarthy, Wee & Steinman, 2011). Even though secondary data analysis uses data collected by others, it still employs the same research steps followed when conducting primary research (*ibid*).

2.2.1 Purpose of secondary data analysis

Secondary data analysis can be used "to investigate new or additional research questions" (Heaton, 2008, p. 35). It can also be used to confirm or substantiate findings from earlier research (*ibid*). In quantitative research the two purposes outlined are more applicable; however, in qualitative research the second purpose creates controversy, and usually reflects one's epistemological orientation (*ibid*).

2.2.2 Secondary data analysis models

Three main models of secondary data analysis can be identified: formal data sharing, informal data sharing and re-use of self-collected data (Heaton, 2008). In formal data sharing researchers gain access to datasets that are made available to the public for secondary data analysis purposes (*ibid*). These types of dataset are usually well documented and have also fulfilled the ethical and legal requirements (*ibid*). In informal data sharing the people who collected the data may give it to other people for secondary data analysis or "may share their data with others who were not involved in the primary research (*ibid*). The final model involves researchers re-using their own self-collected data in order to extend an initial investigation or to confirm or substantiate previous findings (*ibid*).

2.2.3 Advantages of secondary data analysis

Secondary data analysis has a number of advantages that include the following: (1) Reviewing secondary data helps researchers to formulate new research questions for further investigation (Coyer & Gallo, 2005); (2) conducting secondary analysis saves time and money (Boslaugh, 2007); (3) another major advantage is "the breadth of data" that is made available through secondary data analysis (*ibid*). (4) information contained in secondary datasets is often accurate because "the data collection is informed by expertise and professionalism that may not be available to smaller research projects" (*ibid*).

2.2.4 Disadvantages of secondary data analysis

The major disadvantage of using secondary data analysis is "inherent in its nature" because the data was collected to address different research questions, and as such specific information that may be crucial to one's research may not be there (Boslaugh, 2007, p. 4). Another problem may relate to the way in which the data has been categorised; for instance, it may be in categories rather than continuous variables (*ibid*). Some information collected may not be made available to the secondary researcher for confidentiality reasons (*ibid*). Another major problem is that "of not having been there" which has serious implications when it comes to the interpretation of the data (Heaton, 2008, p. 40).

2.3 Professional development

Professional development is an ongoing process whereby individuals or a group of people reflect and examine their practice to become more effective in their practice (Weingarten, Cortese & Johnson, 2008). Professional development ought to empower both individual teachers and groups of teachers in the decision-making process, in problem-solving, in informing their practice by theory and also in improving students' learning (*ibid*). It should also lead to the development of 21st Century skills in both learners and teachers (*ibid*). Vonk (1991) cited in Mushayikwa and Lubben (2009, p. 375) however, defines professional development as "the process of accumulating skills, professional knowledge, values and personal qualities that enable teachers to continually adapt within the educational system."

Self-directed professional development occurs when teachers are intrinsically motivated to undertake professional development activities (Mushayikwa & Lubben, 2009); it implies that "teachers take responsibility for their own actions and acquire the necessary knowledge, skills and repertoire of activities to increase their participation in the school workplace environment" (Teachers' professional development, 2010, p. 32). Professional development emanates from the desire to fill knowledge gaps, and it also depends on the context where teachers work (*ibid*). One key element of professional development is that it is an ongoing and lifelong process (*ibid*).

2.3.1 Importance of professional development

Weingarten et al. (2008) contend that better teaching strategies and improved student learning cannot be realised without professional development. Professional development is perceived as a key ingredient towards "systemic" reform (*ibid*). Moreover, societies have high expectations of teachers and information is increasing and getting more complex (Teachers' professional development, 2010). For teachers to cope with ever-changing environments they need to develop their skills and competencies continuously through ongoing professional development activities (*ibid*). Furthermore, improved student learning greatly depends on teacher quality, and as such it is imperative to provide quality initial teacher training and continuous professional development opportunities (*ibid*).

Regarding the integration and the appropriate use of ICT in instruction and learning, professional development is a major prerequisite but unfortunately in many cases it is often overlooked (UNESCO, 2011). Furthermore, the “lack of effective professional development for teachers is often considered a root cause of the divide between what learners could potentially achieve and the reality they actually face in classrooms throughout the world” (*ibid*). The review of related literature reveals high quality professional development as the main solution to the challenges facing the integration and the appropriate use of ICT in instruction and learning (*ibid*). Schools cannot transform unless the teachers within them change; furthermore, long established culture and practices of organisations can hinder the implementation of new innovations and practices (*ibid*).

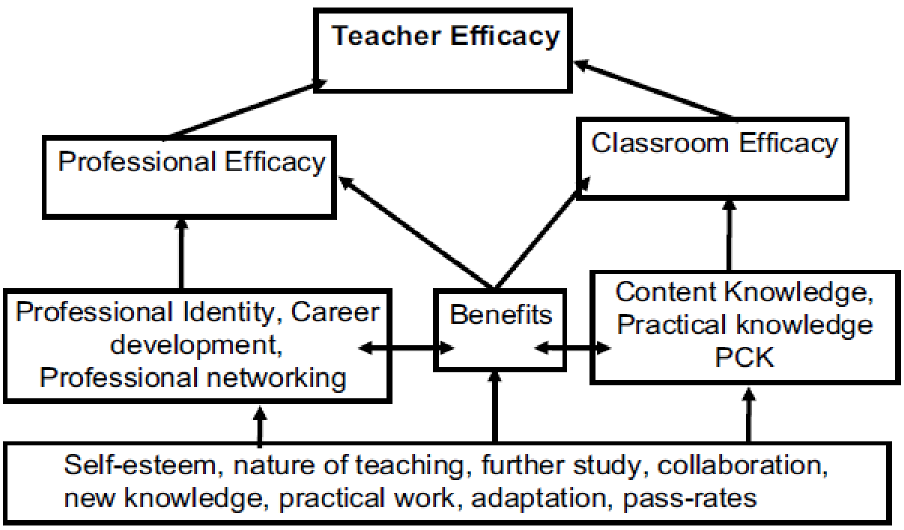
2.3.2 Professional development models

Over the years professional deveolopment has evolved from “a deficit approach” to a “technical approach,” and more recently to “continuing professional development” (Mushayikwa & Lubben, 2009, p. 375). Professional development has shifted from filling knowledge gaps to promoting the self-actualisation of teachers (*ibid*). Teachers are now encouraged to take responsibility for identifying and addressing their own professional development needs (*ibid*). The earlier models of professional development that viewed teacher training as something that was provided by external experts failed (Teachers’ professional development, 2010). More emphasis is now placed on making individual teachers realise the importance of professional growth (*ibid*).

2.3.3 Self-directed professional development model

The model in Figure 2 shows how self-directed professional development leads to teacher efficacy both at professional level and at classroom level. The driving force behind self-regulated professional development emanates from "self esteem, nature of teaching, further study, collaboration, new knowledge, practical work, adaptation and pass rates" (Mushayikwa & Lubben, 2009, p. 380). Self-directed professional development results in improvement of content knowledge, practical knowledge and pedagogical content knowledge and this in turn leads to classroom efficacy (*ibid*). It also leads to an improvement in professional identity, career development and professional networking, which subsequently results in professional efficacy (*ibid*).

Figure 2: Self-directed professional development model



(Mushayikwa & Lubben, 2009)

The framework for ICT in professional development (Figure 3) consists of four main competencies ("content and pedagogy; technical issues; social issues and collaboration and networking") that are supported by four themes ("context and culture; planning and management of change; leadership and vision, and lifelong learning") (UNESCO, 2012, p. 60).

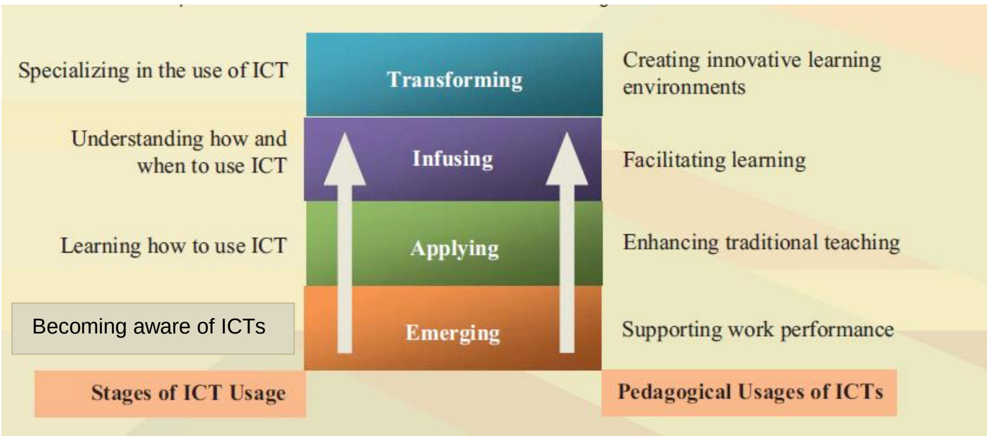
Figure 3: Framework for ICT in professional development

(UNESCO, 2012)

Teachers ought to be knowledgeable about subject content, possess a variety of teaching strategies, appropriately select and use the various technology tools and collaborate and network with other teachers (UNESCO, 2012). For these competencies to be properly nurtured the contexts and cultures where professional development activities occur need to be considered (*ibid*). Long-term vision has to be clearly articulated and good leadership and support need to be ascertained from the administration (*ibid*). Most importantly, institutions need to acknowledge that the development of skills is a lifelong process and as such they should continuously offer professional development activities (*ibid*). Finally, there has to be “careful planning and effective management of the change process” (*ibid*).

The integration and successful use of computers in instruction and learning, through professional development activities, proceed in successive steps identified as *Emerging, Applying, Infusing and Transforming* (UNESCO, 2012, p. 64). The adoption stage is the emerging stage, where teachers have minimal knowledge of ICT and use ICT for very basic pedagogical purposes (*ibid*). However, as teachers progress through the professional development activities towards the transforming stage, the general and pedagogical uses of ICT become more advanced and more complex, and efforts become geared towards student-centred learning (*ibid*) (See Figure 4).

Figure 4: Stages of ICT for professional development



(UNESCO, 2012)

2.4 ICT-related skills

The partnership for 21st Century skills identifies the following ICT-related skills that teachers ought to possess in order to be effective: teachers need to have the necessary skills to access the information that is rapidly increasing since we are living in an information society (Partnership for 21st Century skills, 2009). To do so they need to "use technology as a tool to research, organize, evaluate and communicate information" (*ibid*). Teachers also need to stay abreast of the rapid developments in technology tools by having the required skills to use the different forms of digital technologies such as computers, PDAs, media players, GPSs and so on (*ibid*). They must have the competency to use communication tools and social networks effectively, not only to access information but also to "manage, integrate, evaluate and create information to successfully function in a knowledge economy" (*ibid*). Finally teachers need to be cognisant of the ethical and legal issues such as copyright, plagiarism and piracy involved in the access and use of Internet resources (*ibid*).

2.5 ICT-related pedagogical skills

The partnership for 21st Century skills stresses the importance of using technology tools to create a deep and meaningful understanding in learners (Partnership for 21st

Century skills, 2009). To achieve this teachers need to have a mastery of content knowledge; use a range of ICT-related teaching strategies; make the learning experience of learners meaningful by using real-world examples; use a balance of technology-enhanced formative and summative assessments; explicitly teach learners 21st Century skills, and afford the learners the opportunity to apply what they have learnt in real-life situations and to appreciate the role played by ICT in our modern society (*ibid*).

2.6 Literature based on SITES 2006

2.6.1 The participation of South Africa in SITES 2006

Of the 22 SITES 2006 participating countries South Africa has the lowest number of Internet and cell phone users (78 and 428 users per 1000 people respectively) (Anderson & Plomp, 2008, p. 42 cited in Blignaut, Els & Howie, 2010b, p. 557). All the other SITES participating countries used the online data collection (ODC) method, except for South Africa (Blignaut, Els & Howie, 2010b). Insufficient Internet access in most South African schools rendered the ODC method impossible; hence the personal interview schedule was deemed to be the most appropriate method for South Africa (*ibid*). This method yielded a high return rate of over 90% which is comparatively higher than the 85% required by the IEA (*ibid*). In most variables South Africa scored disappointingly low in comparison to the other 21 SITES participating countries (*ibid*).

2.6.1.1 The context of the South African education system

South Africa has a youthful population with approximately 29.7% people younger than the age of fourteen (Blignaut, Els & Howie, 2010b). The country has a high enrolment rate of over 90% compared to many developing countries (*ibid*). South African government classrooms are overcrowded with an average learner-teacher ratio of 31.8 in public schools (*ibid*). The number of male and female learners who enrol in South African primary and secondary schools is almost equal (59 13189 males and 58 95188 females) (*ibid*). In spite of the Government’s largest spending on education almost 40% of the South African schools are classified as poor or very poor; about 60% South African schools have electricity and 67% have fixed telephone lines (*ibid*). When consolidating these statistics only 20% of South African schools have the basic infrastructure to connect to the Internet (*ibid*).

2.6.1.2 ICT infrastructure

South Africa has not yet reached the level of providing full access to computers and the Internet as opposed to the other SITES 2006 participating countries like Thailand and Chile (Howie & Blignaut, 2009). South Africa has only 38% access to ICT while Thailand and Chile have both 96% access (*ibid*). Of the few South African schools (38%) that have computers, over 60% have an Internet connection (*ibid*). South African schools also have the lowest technology applications like LMS (8%), simulation (3%), multimedia productions (8%) and digital resources (20%) (*ibid*).

According to the National Education Infrastructure Management Systems (NEIMS) report of 2007 most South African schools lack a basic ICT infrastructure and other necessary tools required to realise the 21st Century pedagogical goals (Blignaut, Els & Howie, 2010b). In the countries that participated in SITES 2006 South Africa was the only country with learners with no full access to computers (*ibid*). When South Africa is compared with other SITES 2006 participating education systems it lags behind in terms of providing computers in classrooms for the purposes of instruction and learning (*ibid*). Hong Kong has 69% computers in classrooms for instruction and learning while South Africa has only 0.08% (*ibid*). In countries such as Estonia the overall computer access is 100% and in Chile and Israel it is 96%; for South Africa it is only 38% (*ibid*). However, there has been a notable improvement in terms of schools that have Internet access, from 52% in 1998 [when South Africa participated in SITES Module 1] to 67% in 2006 (*ibid*). Despite this remarkable improvement in Internet access South Africa is the second lowest country in terms of schools that have Internet access (*ibid*). However, there are developing countries that have a relatively higher percentage of schools with Internet access such as Lithuania and Estonia, both with 100% Internet access (*ibid*).

2.6.1.3 ICT integration in instruction and learning (pedagogical practices)

South Africa has the lowest integration of ICT in Mathematics (18%) and Science classrooms (16%) (Howie & Blignaut, 2009). This is very low, especially when we consider the fact that over 40% of all Science teachers in all the other participating countries use ICT, and for countries such as Singapore, Norway and Hong Kong the integration is more than 80% (*ibid*).

South African Mathematics and Science teachers are still unable to propagate in learners 21st Century learning skills (Blignaut, Els & Howie, 2010b). This is exacerbated by the fact that the majority of both South African Mathematics and Science teachers do not have the required ICT competence and therefore a number of these teachers are unable to use ICT for instruction and learning (*ibid*).

To understand the science teachers' pedagogical orientation three sets of indicators were used: curriculum goal orientation, teacher practice orientation and student practice orientation (Draper, Howie & Blignaut, 2011). South African Science teachers' pedagogical practice tends to favour traditional learning in the following ways:

- The Science teachers' practices that are aligned with the 21st Century pedagogy are limited (Draper, Howie & Blignaut, 2011). They had the lowest mean [1.31 to 2.56] on both factors that were related to connectedness (to organise or mediate communication with experts / external mentors and to liaise with collaborators) (*ibid*). However, the Science teachers' practices that fostered traditional learning like classroom management, presenting information or demonstrations or giving class instruction scored the highest mean (*ibid*).
- Learner practices also reflect the traditional practices, for instance students mostly use computers for completing worksheets / exercises, working at the same pace and answering tests (*ibid*).

2.6.1.4 Obstacles hindering the implementation of ICT

The greatest concerns are related to the shortage of ICT for Science laboratory work, which stands at 57% compared to the international average of 40%, and the limited number of computers connected to the Internet (53% as opposed to the international average of 27%) (Howie & Blignaut, 2009). In general South African teachers have low ICT competence, learners lack basic ICT skills, South African Science teachers face the problem of inadequate ICT infrastructure and of a lack of professional development opportunities (Draper, 2010).

2.6.1.5 Availability of support (technical and pedagogical)

Technical support in South Africa has the lowest availability (Howie & Blignaut, 2009). Twenty five percent of South African schools use teachers for providing technical support against the international average of 50%, and this implies that very few teachers in South Africa receive technical support (*ibid*). However, pedagogical support is always readily available for most South African teachers and this kind of support is greater than that received by teachers in Catalonia, Finland and the Russian Federation (*ibid*).

2.6.1.6 Availability of training opportunities for teaching

Training opportunities for South African teachers are limited as opposed to the other SITES 2006 participating countries (Howie & Blignaut, 2009). Of all the in-service training opportunities available for South African teachers, only about 15% of the schools have the opportunity to attend courses that deal with pedagogical issues related to the integration of ICT in instruction and learning (*ibid*). This is disappointingly low especially when compared to the second lowest country Japan, which has 40% attendance (*ibid*).

2.6.2 South Africa compared to other developing countries (Chile and Israel)

2.6.2.1 Access to ICT resources

In terms of access to ICT resources there is a big disparity between South Africa and Chile; South Africa lags far behind in many instances (Blignaut, Hinostroza, Els & Brun 2010a). About 38% of South African schools have computers available for instruction and learning while Chile has a comparatively higher percentage of 96% (Blignaut et al., 2010a). Moreover, only 18% of computers in South African Schools had Internet access contrary to the 90% in Chile (*ibid*). There is a higher need for ICT equipment and applications [needed but not available] such as simulation software (93%), multimedia production tools (90%) and tutorial software (88%) in South Africa than in Chile where it is 49%, 43% and 54% respectively (*ibid*).

With regard to ICT infrastructure only 33% of the Israeli schools have achieved the student computer ratio of 1:10 set by the Ministry of Education (Nachmias, Mioduser & Forkosh-Baruch, 2010). Furthermore, 25% of the Israeli schools have a student computer ratio of more than 1:20 and this places Israel in the lower third of the SITES 2006 participating countries (*ibid*). As in many SITES 2006 participating countries, most computers in Israel are found in computer laboratories and classrooms hardly have the necessary ICT infrastructure (*ibid*). Over 40% of ICT coordinators face the challenge of having old and outdated computers, and inadequate ICT infrastructure and digital resources for instruction and learning (*ibid*).

2.6.2.2 Availability of support (technical and pedagogical)

South African schools have a relatively lower technical support rate (41% and 28% from computer coordinators and teachers respectively) compared to Chile where schools have a higher technical support (88% and 71% from computer coordinators and teachers respectively) (Blignaut et al., 2010a). Also, South African schools spend more money from their coffers to maintain ICT infrastructure (34% compared to the 16% for Chile) (*ibid*). In Chile, however, more support comes from the government (52% as opposed to the 11% for South Africa), which contracts private companies to maintain the ICT infrastructure (*ibid*).

Pedagogical support is particularly important when teachers engage with learners in lifelong activities, such as project work, online collaboration, field studies, etc. (Blignaut et al., 2010a). On a four point Likert scale [1 = not at all; 2 = a little; 3 = somewhat; 4 = a lot] South Africa scored a low mean of 2.3 in terms of pedagogical support for lifelong activities, while Chile scored a mean of 2.8 (*ibid*).

2.6.2.3 ICT integration in instruction and learning (pedagogical practices)

The use of ICT in instruction and learning forms the basis of the SITES 2006 study because it is generally believed that integrating ICT in instruction and learning helps to develop 21^{st} Century skills in learners (Blignaut et al., 2010a, p. 1561). Unfortunately, the use of ICT for teaching and learning in South Africa is very low, 18% in Mathematics and 16% in Science compared to the 56% and 66% for Chilean Mathematics and Science teachers respectively (*ibid*).

ICT usage in Israel is very low and Israel came second last in the list of SITES 2006 participating countries (Nachmias, Mioduser & Forkosh-Baruch, 2010). Twenty two percent of Mathematics teachers and 53% of Science teachers reported to have used ICT once in the previous year (*ibid*).

The majority of Israeli Mathematics and Science teachers do not use ICT innovatively (Nachmias, Mioduser & Forkosh-Baruch, 2010). The use of ICT in instruction and learning perpetrates the traditional paradigm (*ibid*). ICT is used mainly for displaying information and for typing (*ibid*). Israel Mathematics and Science teachers hardly use ICT for online assessment (*ibid*).

2.6.2.4 Availability of training opportunities for teaching

There is a greater need for teachers' professional development in South Africa than in Chile (Blignaut et al., 2010a). This is because a greater percentage of South African teachers did not feel confident in accomplishing many ICT-related tasks compared to teachers in Chile (*ibid*). For example, 50.7% of South African teachers were not confident to prepare lessons that use ICT compared to the 6.9% in Chile (*ibid*). Moreover, there are more courses available for teachers in Chile as opposed to courses available for South African teachers (*ibid*). For example, courses that were available for teachers on pedagogical issues related to the integration of ICT in instruction and learning were 51% in Chile compared to the 15% in South Africa (*ibid*). The percentages were also high for Chile compared to South Africa in all the other courses available for teachers (*ibid*).

2.6.2.5 School level factors

Principals play a pivotal role in the integration of ICT and in enhancing its innovative use (Ho, 2006 cited in Blignaut et al., 2010). The principals' pedagogical visions were grouped into three categories, namely "lifelong learning, connectedness and traditional" (Blignaut et al., 2010a, p. 1560). South African principals are more inclined towards the traditional pedagogy as opposed to their Chilean counterparts who attach more importance to connectedness and lifelong pedagogy (*ibid*). Regarding the vision for traditional pedagogy South African principals scored a mean of 3.60 while Chilean principals scored a mean of 3.53 (*ibid*). As it has already been noted earlier the Chilean principals, on the other hand, scored higher means of 3.29 and 3.65 regarding the vision for connectedness and lifelong learning respectively while the South African principals scored lower means of 3.18 and 3.31 for the vision of connectedness and lifelong learning respectively (*ibid*).

Principals in Israel value the use of ICT in instruction and learning (Nachmias, Mioduser & Forkosh-Baruch, 2010). Fifty three percent of the principals believe that ICT is important in preparing students for future jobs and 58% of the principals believe that ICT is important in preparing students for future skills (*ibid*).

2.6.3 Other selected SITES 2006 participating countries

2.6.3.1 HIMA countries (High percentage of frequently ICT-using Mathematics) and LOMA countries (Low percentage of frequently ICT-using Mathematics)

2.6.3.1(a) School level factors

School principals in HIMA countries as opposed to the principals in LOMA countries play a decisive role in ensuring that learners in their schools develop self-regulated learning skills; for instance, they learn independently, they discover information, process it and present the information, and they proceed with the learning tasks at their own pace (Pelgrum & Voogt, 2009). In HIMA countries learning tasks are organised in such a way that learners engage in cooperative learning activities according to the task at hand, and there is a flexibility in terms of time schedule as the learners can be given more time to complete their projects if need arises (*ibid*). However, in LOMA countries learners follow a fixed schedule when learning (*ibid*). In HIMA countries ICT is part of everyday teaching and computers are found in most classrooms while in LOMA countries ICT is studied as a separate subject and computers are usually found in computer laboratories (*ibid*). School principals in HIMA countries as opposed to their counterparts in LOMA countries play an important part in determining the way in which ICT is used (*ibid*). For example, principals in HIMA countries encourage teachers to use ICT innovatively. In LOMA countries teachers acquire ICT skills through individual efforts (*ibid*).

2.6.3.1(b) Teacher level factors

Teachers in HIMA countries, as opposed to teachers in LOMA countries, use ICT for developing lifelong competencies (Pelgrum & Voogt, 2009). As such learners are involved in self-regulated learning and learning is not only confined to the classroom (*ibid*). Teachers in HIMA countries are involved in reflexive practice as they continuously seek to improve their teaching styles based on their past experiences (*ibid*).

2.6.3.2 Nordic countries (Denmark, Finland and Norway)

2.6.3.2(a) Similarities

In all three Nordic countries (Denmark, Finland and Norway) there are ICT policies that are aimed at promoting the innovative use of ICT in instruction and learning (Ottestad, 2010). All three countries have a well-developed ICT infrastructure, and in terms of ICT infrastructure and computer access these countries are ranked among the top six countries of the countries that participated in the SITES 2006 study (*ibid*).

2.6.3.2(b) Differences

In terms of ICT usage there are differences between these countries with regard to the time spent using ICT and on the different pedagogical practices (Ottestad, 2010). The leader of the three countries is Norway (72% Mathematics teachers and 64% Science teachers) followed by Denmark (69% Mathematics teachers and 62% Science teachers) and finally Finland (23% Mathematics teachers and 58% Science teachers) (*ibid*).

2.6.3.2(b)(i) Policy and curriculum

In Finland the policy gives much autonomy to the teacher to decide how to use ICT for pedagogical purposes, and to identify areas where professional development and support are required (Ottestad, 2010). In Norway teachers have to meet the prescribed curriculum requirements that encourage the use of ICT as a necessary required skill in all subjects (*ibid*). In Denmark ICT has been integrated in all subjects. There are national strategic initiatives in Denmark to ensure the successful integration of ICT in instruction and learning (*ibid*).

When comparing the policies of the three countries Finland seems to be better placed to integrate ICT successfully in instruction and learning since they adopt the bottom-up approach in terms of ICT implementation (*ibid*). The teachers are given the responsibility to take decisions regarding the pedagogical use of ICT. Moreover, professional development is placed in the hands of the Finnish teachers (*ibid*).

2.6.3.2(b)(ii) Differences in pedagogical visions and practice orientations

When looking at the mean scores for the three countries, lifelong learning is more important for Norwegian teachers than for Danish and Finnish teachers (Ottestad, 2010). However, when we consider pair-wise differences the differences between the three countries are not meaningful (*ibid*). Relating to the research question, the Finnish teachers' scores, on the 21^{st} pedagogy vision indicators, are not significantly different from those of the Danish and Norwegian teachers (*ibid*). However, the lifelong learning practice indicators for the Finnish teachers are significantly higher (*ibid*).

2.7 Summary

Since the study is a secondary analysis of the SITES 2006 dataset, it was imperative to review literature on secondary data analysis. Secondary data analysis saves time and money, and also gives the researcher access to a wide range of information that would otherwise not be available to primary researchers (Boslaugh, 2007). The literature on professional development was also reviewed because the major focus of this research is on the ICT development needs of the South African Science and Mathematics teachers. Schools cannot transform unless the teachers within them change; furthermore, long established culture and practices of organisations can hinder the implementation of innovation and new practices (UNESCO, 2011). Professional development affords teachers the opportunity to step out of their comfort zones and explore new ways of doing things. Weingarten et al. (2008) contend that better teaching strategies and improved student learning cannot be realised without professional development.

Particular attention was paid to literature on ICT-related skills and ICT-related pedagogical skills. Teachers need to be competent users of ICT and have the necessary skills to access information (Partnership for 21^{st} Century skills, 2009).

Moreover, teachers should be masters in their subject areas, possess the necessary pedagogical skills, use a range of ICT-related teaching strategies and cultivate 21st Century skills in learners (*ibid*). The final part of the literature review focuses on the literature based on SITES 2006. The focal point of the SITES 2006 survey is the use of ICT in instruction and learning. This is because it is generally believed that integrating ICT in instruction and learning helps to develop the 21st Century skills in learners (Blignaut et al., 2010a). As it has already been noted in the literature, South African Science and Mathematics teachers lag far behind in the integration of ICT in instruction and learning (16% and 18% respectively) (Howie & Blignaut, 2009). There is a great need to improve teachers' ICT competence to improve the integration of ICT in instruction and learning. Blignaut, Els and Howie, (2010b) attribute the low integration of ICT in instruction and learning to the lack of ICT skills of South African teachers. There are other important factors that have been identified in the literature that have a negative effect on the integration of ICT in instruction and learning. These factors include ICT infrastructure (Blignaut, Els & Howie, 2010b), access to computers (Howie & Blignaut, 2009), system level factors (Bryderup, Larson & Trentel, 2009), school level factors (Law, Lee & Chan, 2010) and teacher level factors (Pelgrum & Voogt, 2009). It is also worth noting that improvements in ICT infrastructure do not equal the use of computers to cultivate 21st Century skills among learners. This is because in Denmark there were improvements in ICT infrastructure and access to computers; yet there were negative developments in the pedagogical use of ICT (Bryderup, Larson & Trentel, 2009). Improvements in ICT infrastructure and computer access should be paralleled with policies that are aimed at promoting the integration of ICT in instruction and learning (*ibid*).

Chapter 3 – Research methods

3.1 Introduction

This study follows a basic secondary data analysis of the SITES 2006 dataset relating to South African Science and Mathematics teachers. This chapter (1) outlines the research methods used in this study, (2) explains the sampling procedures, (3) describes the instruments used in collecting the data, and the data collection methods, (4) explains how data was analysed and describes the statistical procedures used to analyse the data, and (5) explains how issues surrounding ethical considerations and data preparation were addressed.

3.2 Research design

This research is a secondary data analysis (SDA) of the SITES 2006 dataset that considered South African Science and Mathematics teachers only. This SDA research adopted an integrated qualitative-quantitative approach. Qualitative data was transformed into quantitative data that was analysed statistically using non-parametric statistic techniques. An integrated qualitative-quantitative approach ensured a holistic and an in-depth analysis of the data. To seek answers to the questions raised in the study an integrated qualitative-quantitative approach was deemed to be the most appropriate approach because the research questions yielded both qualitative and quantitative data.

3.3 Sample

SITES 2006 sampled 451 schools In South Africa, using stratified random sampling (Blignaut, Els & Howie, 2010b). A total of 622 Science and 666 Mathematics teachers were sampled in South Africa (*ibid*). A total of 1288 teachers, comprising 622 Science and 666 Mathematics teachers sampled were considered for this study.

3.4 Instruments for collecting data

For inferential statistics this SDA research used part of the teacher questionnaire (question 23 and question 24) that was administered in the primary study to collect information from both Science and Mathematics teachers. The categories of question 23 that were considered are shown in Figure 5.

Figure 5: Question 23C and Question 23D

Do you experience the following obstacles in using ICT in your teaching?
Please mark only one choice in each row

	1 No	2 Yes
C. I do not have the required ICT-related skills. **BTG23C1**	☐	☐
D. I do not have the necessary ICT-related pedagogical skills. **BTG23D1**	☐	☐

The categories of question 24 that were considered are shown in Figure 6.

Figure 6: Question 24A, Question 24C and Question 24E

Have you participated in any of the following professional development activities? If no, would you wish to attend?
Please mark only one choice in each row.

	1 No, I do Not wish to attend	2 No, I would like to attend if available	3 Yes, I have
A. Introductory course in Internet use and general applications (e.g., basic word-processing, spreadsheets, databases, etc.).**BTG24A1**	☐	☐	☐
C. Advanced course in applications / standard tools (e.g., advanced word-processing, complex relational databases, etc.).**BTG24C1**	☐	☐	☐
E. Course on pedagogical issues related to integrating ICT Into instruction and learning.**BTG24E1**	☐	☐	☐

For descriptive statistics the following questions were considered: (29) access to a computer at home; (31) age groups; (32) gender; (33) level of education; (34)

Bachelor's degree; (35) teaching licence, and (36) years of teaching experience (See Addendum C).

3.5 Data collection methods

The data for the secondary data analysis was collected from the IEA data repository. This is the universal data set that consists of twenty two countries that participated in the IEA SITES 2006 study. The database consists of national contexts and school and teacher level data. For the purposes of this SDA study the subset of the universal data set was then queried by indicating the name of the country, Science / Mathematics teacher and the format (SPSS or SAS XPORT). The subset consisted of 622 Science teachers' records and 666 Mathematics teachers' records. The data that was used in this research is the teacher level data.

3.6 Framework for data analysis

This section does not only identify the variables used in the study but also gives a detailed description of each variable in terms of variable type, number of categories, information relating to the database where the variables were extracted and the statistical techniques that were used to analyse the data. The variables were grouped into two categories, namely variables for descriptive statistics and variables for inferential statistics. The variables identified and described yielded information that was required to answer the questions raised in the study. A one-way chi-square analysis (for 2 X 1 cross tabs) and a two-way chi-square analysis (for 2 X 2 cross tabs) were used to determine if there is any statistical significant difference in frequencies relating to each variable tested. A significant level of 5% ($\propto = 0, 5$) was used to conclude whether or not the difference is statistically significant. In other instances probability calculations were done. Pie charts, bar graphs and cross tabs were used to depict the data.

3.6.1 Variables for descriptive statistics

Table 2 shows all the variables that were used for the descriptive statistics.

Table 2: Variables for descriptive statistics

	Variable name / description and type; number of categories			Database		Analysis
No	**Variable name / description**	**Variable type**	**Number of categories**	**File name**	**Field name**	**Statistical techniques**
1	Access to a computer at home	Categorical; nominal; dichotomous	2	BTSZAFS1.sav and BTMZAFS1.sav (merged)	BTG29A1	• One-way chi-square analysis • Pie chart
2	Age group	Categorical; ordinal; polytomous	6	BTSZAFS1.sav and BTMZAFS1.sav (merged)	BTG31A1	• One-way chi-square analysis • Bar graph
3	Gender	Categorical; nominal; dichotomous	2	BTSZAFS1.sav and BTMZAFS1.sav (merged)	BTG32A1	• One-way chi-square analysis • Pie chart
4	Level of education	Categorical; ordinal; polytomous	4	BTSZAFS1.sav and BTMZAFS1.sav (merged)	BTG33A1	• One-way chi-square analysis • Bar graph
5	Bachelor’s degree	Categorical; ordinal; polytomous	4	BTSZAFS1.sav and BTMZAFS1.sav (merged)	BTG34A1	• One-way chi-square analysis • Bar graph

Table 2: **Variables for descriptive statistics (continued)**

	Variable name / description and type; number of categories			Database		• Analysis
No	**Variable name / description**	**Variable type**	**Number of categories**	**File name**	**Field name**	**Statistical techniques**
6	Teaching licence or certificate	Categorical; nominal; dichotomous	2	BTSZAFS1.sav and BTMZAFS1.sav (merged)	BTG35A1	• One-way chi-square analysis • Pie chart
7	Years of teaching experience	Categorical; ordinal; polytomous	5	BTSZAFS1.sav and BTMZAFS1.sav (merged)	BTG36A1	• One-way chi-square analysis • Bar graph

3.6.2 Variables for inferential statistics: Part I

Table 3 shows the variables that were used for inferential statistics to answer research question 1(a).

Table 3: Variables for inferential statistics: Part I

	Variable name / description and type; number of categories			Database		Analysis
No	**Variable name / description**	**Variable type**	**Number of categories**	**File name**	**Field name**	**Statistical techniques**
1	Experience a lack of ICT-related skill as an obstacle	Categorical; nominal; dichotomous	2	BTSZAFS1.sav and BTMZAFS1.sav (merged)	BTG23C1	• One-way chi-square analysis • Pie chart
2	Experience a lack of ICT-related skill as an obstacle	Categorical; nominal; dichotomous	2	BTSZAFS1.sav and BTMZAFS1.sav (merged)	BTG23C1	• Two-way chi-square analysis • Bar graph
3	Access to a computer at home	Moderator; categorical; ordinal; dichotomous	2	BTSZAFS1.sav and BTMZAFS1.sav (merged)	BTG29A1	
4	Experience a lack of ICT-related skill as an obstacle	Categorical; nominal; dichotomous	2	BTSZAFS1.sav and BTMZAFS1.sav (merged)	BTG23C1	• Two-way chi-square analysis • Probability calculations • Bar graph
5	Age group	Moderator; ordinal; dichotomous	2	BTSZAFS1.sav and BTMZAFS1.sav (merged)	BTG31A1	

Table 3: Variables for inferential statistics: Part I (continued)

	Variable name / description and type; number of categories			Database		Analysis
No	**Variable name / description**	**Variable type**	**Number of categories**	**File name**	**Field name**	**Statistical techniques**
6	Experience a lack of ICT-related skill as an obstacle	Categorical; nominal; dichotomous	2	BTSZAFS1.sav and BTMZAFS1.sav (merged)	BTG23C1	• Two-way chi-square analysis • Probability calculations • Bar graph
7	Gender	Moderator; categorical; nominal; dichotomous	2	BTSZAFS1.sav and BTMZAFS1.sav (merged)	BTG32A1	
8	Experience a lack of ICT-related skill as an obstacle	Categorical; nominal; dichotomous	2	BTSZAFS1.sav and BTMZAFS1.sav (merged)	BTG23C1	• Two-way chi-square analysis • Probability calculations • Bar graph
9	Level of education	Moderator; categorical; ordinal; dichotomous	2	BTSZAFS1.sav and BTMZAFS1.sav (merged)	BTG33A1	
10	Experience a lack of ICT-related skill as an obstacle	Categorical; nominal; dichotomous	2	BTSZAFS1.sav and BTMZAFS1.sav (merged)	BTG23C1	• Two-way chi-square analysis • Probability calculations • Bar graph
11	Bachelor’s degree	Moderator; categorical; ordinal; dichotomous	2	BTSZAFS1.sav and BTMZAFS1.sav (merged)	BTG34A1	

Table 3: Variables for inferential statistics: Part I (continued)

	Variable name / description and type; number of categories			Database		Analysis
No	**Variable name / description**	**Variable type**	**Number of categories**	**File name**	**Field name**	**Statistical techniques**
12	Experience a lack of ICT-related skill as an obstacle	Categorical; nominal; dichotomous	2	BTSZAFS1.sav and BTMZAFS1.sav (merged)	BTG23C1	• Two-way chi-square analysis • Probability calculations • Bar graph
13	Teaching licence or certificate	Moderator; categorical; nominal; dichotomous	2	BTSZAFS1.sav and BTMZAFS1.sav (merged)	BTG35A1	
14	Experience a lack of ICT-related skill as an obstacle	Categorical; nominal; dichotomous	2	BTSZAFS1.sav and BTMZAFS1.sav (merged)	BTG23C1	• Two-way chi-square analysis • Probability calculations • Bar graph
15	Years of teaching experience	Moderator; categorical; ordinal; dichotomous	2	BTSZAFS1.sav and BTMZAFS1.sav (merged)	BTG36A1	

3.6.3 Variables for inferential statistics: Part II

Table 4 shows the variables that were used for inferential statistics to answer research question 1(b).

Table 4: Variables for inferential statistics: Part II

	Variable name / description and type; number of categories			Database		Analysis
No	**Variable name / description**	**Variable type**	**Number of categories**	**File name**	**Field name**	**Statistical techniques**
1	Participation in an introductory course in Internet use and general applications and their willingness to attend	Categorical; ordinal; polytomous	3	BTSZAFS1.sav and BTMZAFS1.sav (merged)	BTG24A1	• One-way chi-square analysis • Cross tab
2	Participation in an introductory course in Internet use and general applications and their willingness to attend	Categorical; ordinal; polytomous	3	BTSZAFS1.sav and BTMZAFS1.sav (merged	BTG24A1	• Two-way chi-square analysis • Cross tab
3	Access to a computer at home	Moderator categorical; ordinal; dichotomous	2	BTSZAFS1.sav and BTMZAFS1.sav (merged)	BTG29A1	

Table 4: Variables for inferential statistics: Part II (continued)

	Variable name / description and type; number of categories			Database		Analysis
No	**Variable name / description**	**Variable type**	**Number of categories**	**File name**	**Field name**	**Statistical techniques**
4	Participation in an introductory course in Internet use and general applications and their willingness to attend	Categorical; ordinal; polytomous	3	BTSZAFS1.sav and BTMZAFS1.sav (merged)	BTG24A1	• Two-way chi-square analysis • Cross tab
5	Age group	Moderator; categorical; ordinal; dichotomous	2	BTSZAFS1.sav and BTMZAFS1.sav (merged)	BTG31A1	
6	Participation in an introductory course in Internet use and general applications and their willingness to attend	Categorical; ordinal; polytomous	3	BTSZAFS1.sav and BTMZAFS1.sav (merged)	BTG24A1	• Two-way chi-square analysis • Cross tab
7	Gender	Moderator; categorical; nominal; dichotomous	2	BTSZAFS1.sav and BTMZAFS1.sav (merged)	BTG32A1	

Table 4: Variables for inferential statistics: Part II (continued)

	Variable name / description and type; number of categories			Database		Analysis
No	**Variable name / description**	**Variable type**	**Number of categories**	**File name**	**Field name**	**Statistical techniques**
8	Participation in an introductory course in Internet use and general applications and their willingness to attend	Categorical; ordinal; polytomous	3	BTSZAFS1.sav and BTMZAFS1.sav (merged)	BTG24A1	• Two-way chi-square analysis • Cross tab
9	Level of education	Moderator; categorical; ordinal; dichotomous	2	BTSZAFS1.sav and BTMZAFS1.sav (merged)	BTG33A1	
10	Participation in an introductory course in Internet use and general applications and their willingness to attend	Categorical; ordinal; polytomous	3	BTSZAFS1.sav and BTMZAFS1.sav (merged)	BTG24A1	• Two-way chi-square analysis • Cross tab
11	Bachelor’s degree	Moderator; categorical; ordinal; dichotomous	2	BTSZAFS1.sav and BTMZAFS1.sav (merged)	BTG34A1	

Table 4: Variables for inferential statistics: Part II (continued)

	Variable name / description and type; number of categories			Database		Analysis
No	**Variable name / description**	**Variable type**	**Number of categories**	**File name**	**Field name**	**Statistical techniques**
12	Participation in an introductory course in Internet use and general applications and their willingness to attend	Categorical; ordinal; polytomous	3	BTSZAFS1.sav and BTMZAFS1.sav (merged)	BTG24A1	• Two-way chi-square analysis • Cross tab
13	Teaching licence or certificate	Moderator; categorical; nominal; dichotomous	2	BTSZAFS1.sav and BTMZAFS1.sav (merged)	BTG35A1	
14	Participation in an introductory course in Internet use and general applications and their willingness to attend	Categorical; ordinal; polytomous	3	BTSZAFS1.sav and BTMZAFS1.sav (merged)	BTG24A1	• Two-way chi-square analysis • Cross tab
15	Years of teaching experience	Moderator; categorical; ordinal; dichotomous	2	BTSZAFS1.sav and BTMZAFS1.sav (merged)	BTG36A1	
16	Participation in an advanced course in applications / standard tools and their willingness to attend	Categorical; ordinal; polytomous	3	BTSZAFS1.sav and BTMZAFS1.sav (merged)	BTG24C1	• One-way chi-square analysis • Cross tab

Table 4: Variables for inferential statistics: Part II (continued)

	Variable name / description and type; number of categories			Database		Analysis
No	**Variable name / description**	**Variable type**	**Number of categories**	**File name**	**Field name**	**Statistical techniques**
17	Participation in an advanced course in applications / standard tools and their willingness to attend	Categorical; ordinal; polytomous	3	BTSZAFS1.sav and BTMZAFS1.sav (merged)	BTG24C1	• Two-way chi-square analysis • Cross tab
18	Access to a computer at home	Moderator; categorical; nominal; dichotomous	2	BTSZAFS1.sav and BTMZAFS1.sav (merged)	BTG29C1	
19	Participation in advanced course in applications / standard tools and their willingness to attend	Categorical; ordinal; polytomous	3	BTSZAFS1.sav and BTMZAFS1.sav (merged)	BTG24C1	• Two-way chi-square analysis • Cross tab
20	Age group	Moderator; categorical; ordinal; dichotomous	2	BTSZAFS1.sav and BTMZAFS1.sav (merged)	BTG31A1	

Table 4: Variables for inferential statistics: Part II (continued)

	Variable name / description and type; number of categories			Database		Analysis
No	**Variable name / description**	**Variable type**	**Number of categories**	**File name**	**Field name**	**Statistical techniques**
21	Participation in advanced course in applications / standard tools and their willingness to attend	Categorical; ordinal; polytomous	3	BTSZAFS1.sav and BTMZAFS1.sav (merged)	BTG24C1	• Two-way chi-square analysis • Cross tab
22	Gender	Moderator; Categorical; nominal; dichotomous	2	BTSZAFS1.sav and BTMZAFS1.sav (merged)	BTG32A1	
23	Participation in an advanced course in applications / standard tools and their willingness to attend	Categorical; ordinal; polytomous	3	BTSZAFS1.sav and BTMZAFS1.sav (merged)	BTG24C1	• Two-way chi-square analysis • Cross tab
24	Level of education	Moderator; categorical; ordinal; dichotomous	2	BTSZAFS1.sav and BTMZAFS1.sav (merged)	BTG33A1	
25	Participation in an advanced course in applications / standard tools and their willingness to attend	Categorical; ordinal; polytomous	3	BTSZAFS1.sav and BTMZAFS1.sav (merged)	BTG24C1	• Two-way chi-square analysis • Cross tab
26	Bachelor's degree	Moderator; categorical; ordinal; dichotomous	2	BTSZAFS1.sav and BTMZAFS1.sav (merged)	BTG34A1	

Table 4: Variables for inferential statistics: Part II (continued)

	Variable name / description and type; number of categories			Database		Analysis
No	**Variable name / description**	**Variable type**	**Number of categories**	**File name**	**Field name**	**Statistical techniques**
27	Participation in an advanced course in applications / standard tools and their willingness to attend	Categorical; ordinal; polytomous	3	BTSZAFS1.sav and BTMZAFS1.sav (merged	BTG24C1	• Two-way chi-square analysis • Cross tab
28	Teaching licence	Moderator; categorical; nominal; dichotomous	2	BTSZAFS1.sav and BTMZAFS1.sav (merged	BTG35A1	
29	Participation in an advanced course in applications / standard tools and their willingness to attend	Categorical; ordinal; polytomous	3	BTSZAFS1.sav and BTMZAFS1.sav (merged	BTG24C1	• Two-way chi-square analysis • Cross tab
30	Years of teaching experience	Moderator; categorical; ordinal; dichotomous	2	BTSZAFS1.sav and BTMZAFS1.sav (merged	BTG36A1	

3.6.4 Variables for inferential statistics: Part III

Table 5 shows the variables that were used for inferential statistics to answer research question 2(a).

Table 5: Variables for inferential statistics: Part III

	Variable name / description and type; number of categories			**Database**		**Analysis**
No	**Variable name / description**	**Variable type**	**Number of categories**	**File name**	**Field name**	**Statistical techniques**
1	Experience a lack of required pedagogical skills as an obstacle	Categorical; nominal; dichotomous	2	BTSZAFS1.sav and BTMZAFS1.sav (merged)	BTG23D1	• One-way chi-square analysis • Pie chart
2	Experience a lack of required pedagogical skills as an obstacle	Categorical; nominal; dichotomous	2	BTSZAFS1.sav and BTMZAFS1.sav (merged)	BTG23D1	• Two-way chi-square analysis • Probability calculations • Bar graph
3	Access to a computer at home	Moderator; categorical; ordinal; dichotomous	2	BTSZAFS1.sav and BTMZAFS1.sav (merged)	BTG29A1	

Table 5: Variables for inferential statistics: Part III (continued)

	Variable name / description and type; number of categories			Database		Analysis
No	Variable name / description	Variable type	Number of categories	File name	Field name	Statistical techniques
4	Experience a lack of required pedagogical skills as an obstacle	Categorical; nominal; dichotomous	2	BTSZAFS1.sav and BTMZAFS1.sav (merged)	BTG23D1	• Two-way chi-square analysis • Probability calculations • Bar graph
5	Age group	Moderator; categorical; ordinal; dichotomous	2	BTSZAFS1.sav and BTMZAFS1.sav (merged)	BTG31A1	
6	Experience a lack of required pedagogical skills as an obstacle	Categorical; nominal; dichotomous	2	BTSZAFS1.sav and BTMZAFS1.sav (merged)	BTG23D1	• Two-way chi-square analysis • Probability calculations • Bar graph
7	Gender	Moderator; categorical; nominal; dichotomous	2	BTSZAFS1.sav and BTMZAFS1.sav (merged)	BTG32A1	
8	Experience a lack of required pedagogical skills as an obstacle	Categorical; nominal; dichotomous	2	BTSZAFS1.sav and BTMZAFS1.sav (merged)	BTG23D1	• Two-way chi-square analysis • Probability calculations • Bar graph
9	Level of education	Moderator; categorical; ordinal; dichotomous	2	BTSZAFS1.sav and BTMZAFS1.sav (merged)	BTG33A1	

Table 5: Variables for inferential statistics: Part III (continued)

	Variable name / description and type; number of categories			Database		Analysis
No	**Variable name / description**	**Variable type**	**Number of categories**	**File name**	**Field name**	**Statistical techniques**
10	Experience a lack of required pedagogical skills as an obstacle	Categorical; nominal; dichotomous	2	BTSZAFS1.sav and BTMZAFS1.sav (merged)	BTG23D1	• Two-way chi-square analysis • Probability calculations • Bar graph
11	Bachelor's degree	Moderator; categorical; nominal; dichotomous	2	BTSZAFS1.sav and BTMZAFS1.sav (merged)	BTG34A1	
12	Experience a lack of required pedagogical skills as an obstacle	Categorical; nominal; dichotomous	2	BTSZAFS1.sav and BTMZAFS1.sav (merged)	BTG23D1	• Two-way chi-square analysis • Probability calculations • Bar graph
13	Teaching licence of certificate	Moderator; categorical; nominal; dichotomous	2	BTSZAFS1.sav and BTMZAFS1.sav (merged)	BTG35A1	
14	Experience a lack of required pedagogical skills as an obstacle	Categorical; nominal; dichotomous	2	BTSZAFS1.sav and BTMZAFS1.sav (merged)	BTG23D1	• Two-way chi-square analysis • Probability calculations • Bar graph
15	Years of teaching experience	Moderator; categorical; ordinal; dichotomous	2	BTSZAFS1.sav and BTMZAFS1.sav (merged)	BTG36A1	

3.6.5 Variables for inferential statistics: Part IV

Table 6 shows the variables that were used for inferential statistics to answer research question 2(b).

Table 6: Variables for inferential statistics: Part IV

	Variable name / description and type; number of categories			Database		Analysis
No	**Variable name / description**	**Variable type**	**Number of categories**	**File name**	**Field name**	**Statistical techniques**
1	Experience a lack of required pedagogical skills as an obstacle	Categorical; nominal; dichotomous	2	BTSZAFS1.sav and BTMZAFS1.sav (merged)	BTG23D1	• One-way chi-square analysis • Cross tab
2	Participation in a course on pedagogical issues related to integrating ICT into instruction and learning and their willingness to attend	Categorical; ordinal; polytomous	3	BTSZAFS1.sav and BTMZAFS1.sav (merged)	BTG24E1	• Two-way chi-square analysis • Cross tab
3	Access to a computer at home	Moderator; categorical; nominal; dichotomous	2	BTSZAFS1.sav and BTMZAFS1.sav (merged)	BTG29A1	

Table 6: Variables for inferential statistics: Part IV (continued)

	Variable name / description and type; number of categories			Database		• Analysis
No	**Variable name / description**	**Variable type**	**Number of categories**	**File name**	**Field name**	**Statistical techniques**
4	Participation in a course on pedagogical issues related to integrating ICT into instruction and learning and their willingness to attend	Categorical; ordinal; polytomous	3	BTSZAFS1.sav and BTMZAFS1.sav (merged)	BTG24E1	• Two-way chi-square analysis • Cross tab
5	Age group	Moderator; categorical; ordinal; dichotomous	2	BTSZAFS1.sav and BTMZAFS1.sav (merged)	BTG31A1	
6	Participation in a course on pedagogical issues related to integrating ICT into instruction and learning and their willingness to attend	Categorical; ordinal; polytomous	3	BTSZAFS1.sav and BTMZAFS1.sav (merged)	BTG24E1	• Two-way chi-square analysis • Cross tab
7	Gender	Moderator; categorical; nominal; dichotomous	2	BTSZAFS1.sav and BTMZAFS1.sav (merged)	BTG32A1	

Table 6: Variables for inferential statistics: Part IV (continued)

	Variable name / description and type; number of categories			Database		Analysis
No	**Variable name / description**	**Variable type**	**Number of categories**	**File name**	**Field name**	**Statistical techniques**
8	Participation in a course on pedagogical issues related to integrating ICT into instruction and learning and their willingness to attend	Categorical; ordinal; polytomous	3	BTSZAFS1.sav and BTMZAFS1.sav (merged)	BTG24E1	• Two-way chi-square analysis • Cross tab
9	Level of education	Moderator; categorical; ordinal; dichotomous	2	BTSZAFS1.sav and BTMZAFS1.sav (merged)	BTG33A1	
10	Participation in a course on pedagogical issues related to integrating ICT into instruction and learning and their willingness to attend	Categorical; ordinal; polytomous	3	BTSZAFS1.sav and BTMZAFS1.sav (merged)	BTG24E1	• Two-way chi-square analysis • Cross tab
11	Bachelor's degree	Moderator; categorical; ordinal; dichotomous	2	BTSZAFS1.sav and BTMZAFS1.sav (merged)	BTG34A1	

Table 6: Variables for inferential statistics: Part IV (continued)

	Variable name / description and type; number of categories			Database		Analysis
No	Variable name / description	Variable type	Number of categories	File name	Field name	Statistical techniques
12	Participation in a course on pedagogical issues related to integrating ICT into instruction and learning and their willingness to attend	Categorical; ordinal; polytomous	3	BTSZAFS1.sav and BTMZAFS1.sav (merged)	BTG24E1	• Two-way chi-square analysis • Cross tab
13	Teaching licence or certificate	Moderator; categorical; nominal; dichotomous	2	BTSZAFS1.sav and BTMZAFS1.sav (merged)	BTG35A1	
14	Participation in a course on pedagogical issues related to integrating ICT into instruction and learning and their willingness to attend	Categorical; ordinal; polytomous	3	BTSZAFS1.sav and BTMZAFS1.sav (merged)	BTG24E1	• Two-way chi-square analysis • Cross tab
15	Years of teaching experience	Moderator; categorical; ordinal; dichotomous	2	BTSZAFS1.sav and BTMZAFS1.sav (merged)	BTG36A1	

3.7 Ethical considerations

One of the advantages of doing a secondary data analysis is that researchers “gain access to data without accessing personal information that may compromise an individual’s confidentiality” (Coyer & Gallo, 2005). Before the study was conducted, the researcher applied for ethical clearance from the Ethics Committee of the Faculty of Education, University of Pretoria. The research commenced only after ethics clearance had been obtained from the Ethics Committee. The data was rendered anonymous for secondary data analysis – the original research participants are not identifiable. The results of the study have been recorded as accurately as possible and personal bias and opinion have not influenced the conclusions drawn from the study.

3.8 Data preparation

Since this is a secondary data analysis the researcher carefully studied the codebook used in the primary research. The codebook provides a clear description of all the variables used in the database. The codebook contains some of the following important elements; variable name, variable description and variable format. The researcher chose the appropriate variables for the research. Since the datasets for Science and Mathematics teachers were separate, the researcher had to merge them into one. After merging the datasets the researcher had to screen the dataset for completeness and accuracy. In other instances the researcher had to recode the categorical variables to new and fewer variables by combining certain variables.

Chapter 4 – Data Analysis

4.1 Introduction

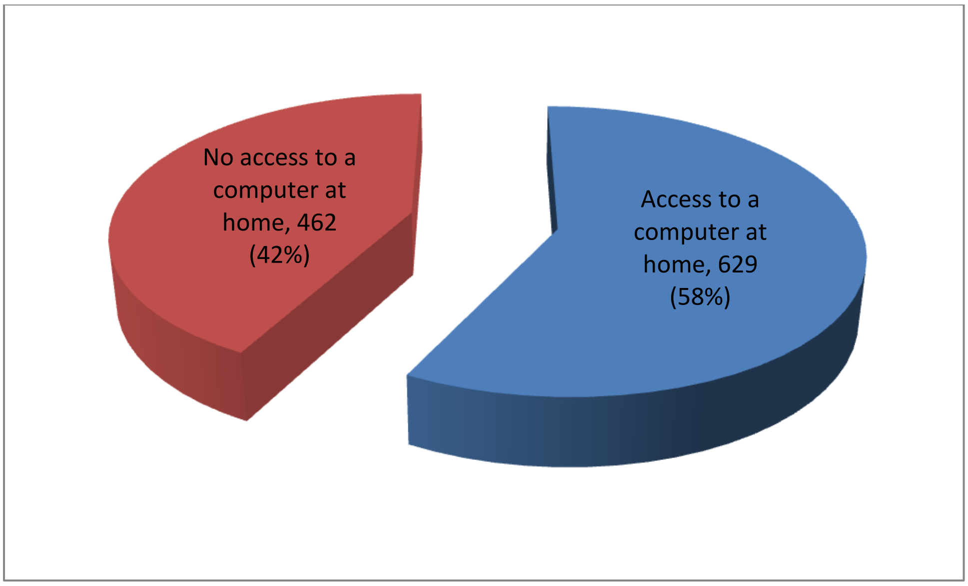
This secondary data analysis research of the SITES 2006 dataset explores the training needs of South African Science and Mathematics teachers relating to ICT and their willingness to be trained. This chapter (1) outlines the general characteristics of the South African Science and Mathematics teachers who participated in the SITES 2006 study in terms of gender, age group, level of education, teaching experience and access to a computer at home; and (2) identifies the specific variables used in the study to explore not only the training needs of South African Science and Mathematics teachers but also to determine their willingness to be trained.

4.2 General characteristic of the Science and Mathematics teachers

4.2.1 Access to a computer at home for the Science and Mathematics teachers

Figure 7 shows that there are 58% (629) Science and Mathematics teachers who have access to a computer at home and 42% (462) who do not have access to one (See Addendum A 5). The main implication of having access to a computer at home is that these teachers are more disposed to learn both general ICT-related skills and pedagogical skills required for the integration of ICT in the instruction and learning process. The one-way chi-square statistics results have revealed that there is a statistical significant difference between the number of Science and Mathematics teachers who have access to a computer at home and those who do not have access to one: (χ^2 (1, 1091) = 25,563 $p <$,05) (See Addendum A 5. 1).

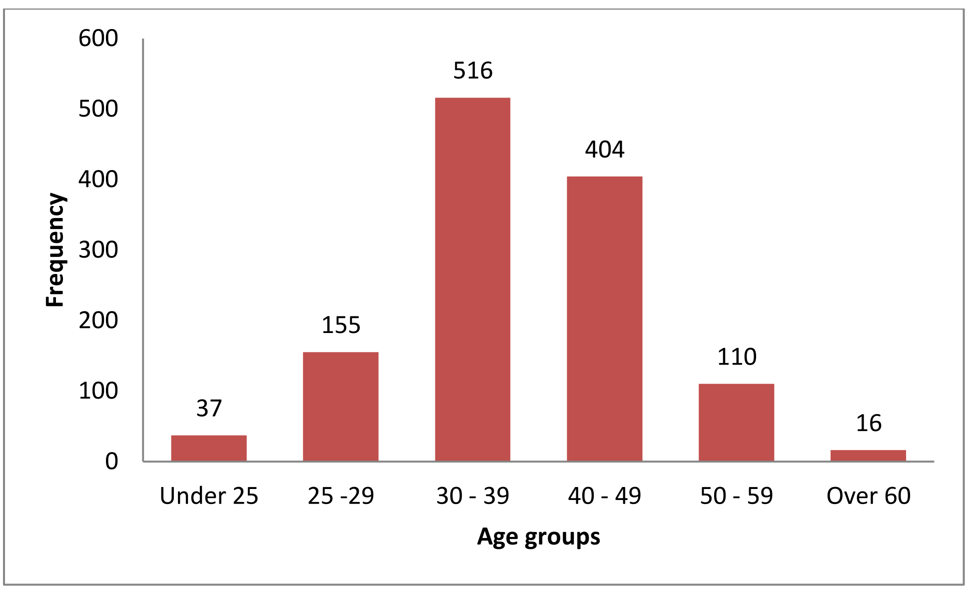
Figure 7: Science and Mathematics teachers' access to a computer at home



4.2.2 Age groups of Science and Mathematics teachers

As shown in Figure 8, in terms of age groups, the majority of Science and Mathematics teachers fall into the 30 - 39 and 40 - 49 age groups (42% and 33% respectively) (See Addendum A 2).

Figure 8: Age groups of Science and Mathematics teachers

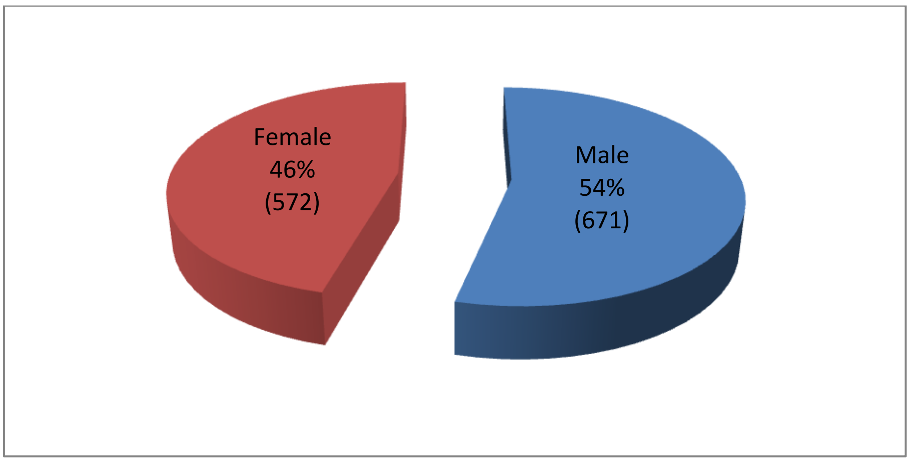


The one-way chi-square statistics results have revealed that there is a statistical significant difference between the number of Science and Mathematics teachers who fall into the different age groups: (χ^2 (5, 1238) = 1026,404, p < ,05) (See Addendum A 2. 1).

4.2.3 Gender distribution of Science and Mathematics teachers

The graph, shown in Figure 9, reveals that more females (54%) than males (46%) participated in the SITES 2006 survey (See Addendum A1). The one-way chi-square statistics results revealed that there is a statistical significant difference between the number of male and female Science and Mathematics teachers who participated in the SITES 2006 survey (χ^2 (1, 1243) = 7,885, p < ,05) (see Addendum A 1.1).

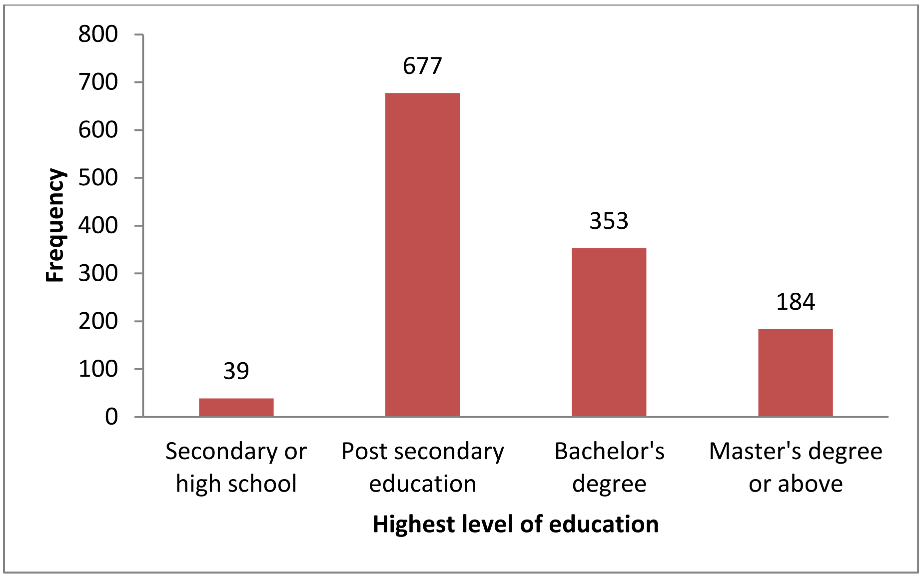
Figure 9: Gender distribution of Science and Mathematics teachers



4.2.4 Level of education of Science and Mathematics teachers

As shown in Figure 10, in terms of highest level of education, only 43% of the Science and Mathematics teachers reported possess either a bachelor's degree or a master's degree or higher qualification (28% and 15% respectively). A total of 54% (677) of the teachers hold a post-secondary education certificate. Only 3% percent (39) of the Science and Mathematics teachers hold a secondary or high school certificate (See Addendum A 3). There is a statistically significant difference between the number of Science and Mathematics teachers and their respective level of education: (χ^2 (3, 1253) = 720,871, p < , 05) (See Addendum A 3. 1).

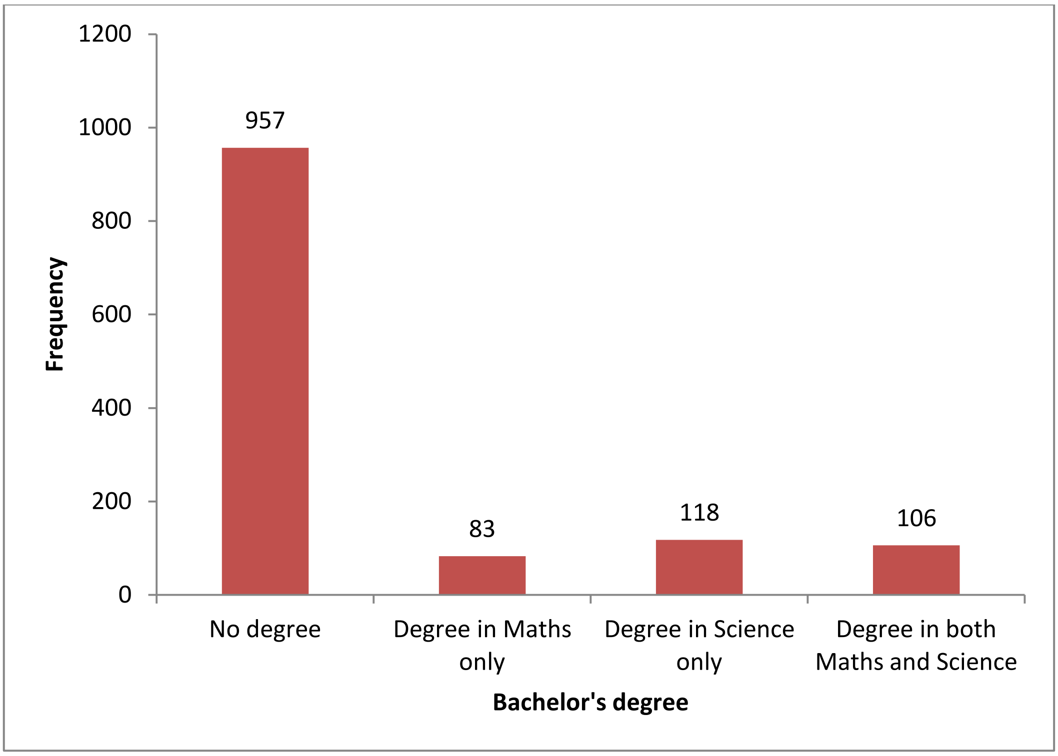
Figure 10: Level of education of Science and Mathematics teachers



4.2.5 Bachelor's degree obtained by Science and Mathematics teachers

Figure 11 shows that 76% (957) of South African Science and Mathematics teachers reported that they do not have a degree in either Mathematics or Science. Seven percent (83) of these teachers have a degree in Mathematics only while 9% (118) have a degree in Science only. Only 8% (106) of the teachers reported having a degree in both Mathematics and Science (See Addendum A 6). The one-way chi-square statistics results have revealed that there is a statistical significant difference between the number of Science and Mathematics teachers who have no degree, who have a degree in Mathematics only, who have a degree in Science only and those who have a degree in both Mathematics and Science:
(χ^2 (3, 1264) = 1735,677, p < ,05) (See Addendum A 6.1).

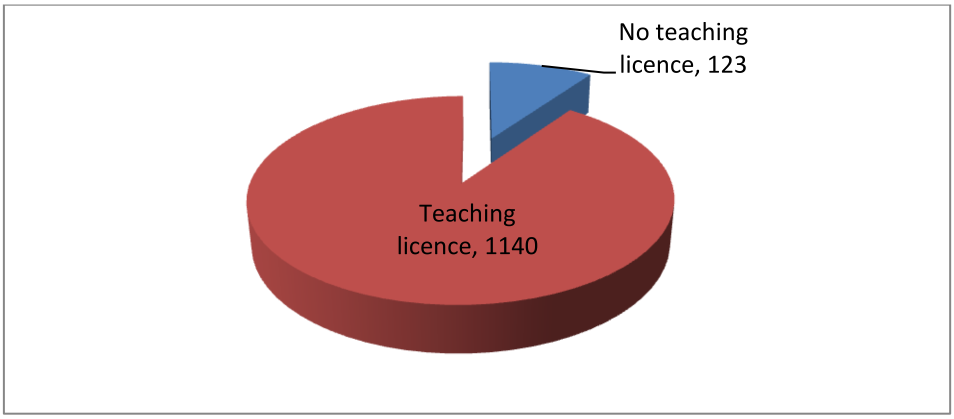
Figure 11: Bachelor's degree obtained by Science and Mathematics teachers



4.2.6 Teaching licence or certificate obtained by Science and Mathematics teachers

As shown in Figure 12, 89% (1140) of South African Science and Mathematics teachers have a teaching licence or certificate. Only 10% (123) teachers do not have one (See Addendum A 7). The one-way chi-square statistics results have revealed that there is a statistical significant difference between the number of Science and Mathematics teachers who have a teaching licence and those who do not have one: (χ^2 (1, 1263) = 818,914, $p <$,05) (See Addendum A 7.1).

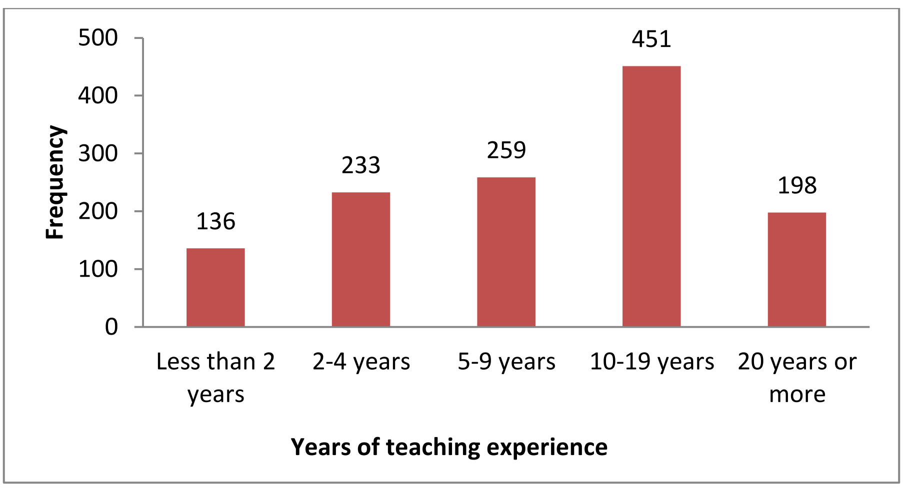
Figure 12: Teaching licence or certificate of Science and Mathematics teachers



4.2.7 Years of teaching experience of Science and Mathematics teachers

As shown in Figure 13, 71% (908) of Science and Mathematics teachers have more than five years' teaching experience (See Addendum A 4). The one-way chi-square statistics results have revealed that there is a statistical significant difference between the number of years of experience in teaching Science or Mathematics for Science and Mathematics teachers: (χ^2 (4, 1277) = 220,537, p < ,05) (See Addendum A 4.1).

Figure 13: Science and Mathematics teachers' teaching experience



4.2.8 Summary

A closer analysis of the one-way chi-square statistical results, shown in Table 7, reveals that the number of teachers who have access to a computer at home and those who do not have access to one is statistically significantly different: (χ^2 (3, 1091) = 26,563, p < ,05). The same is true regarding the number of teachers who fall into different age groups: (χ^2 (5, 1238) = 1026,404, p < ,05). Similarly, there is a statistically significant difference between the number of male and female Science and Mathematics teachers: (χ^2 (1, 1243) = 7,885, p < ,05). The one-way chi-square statistical results for the number of Science and Mathematics teachers who have a secondary / high school certificate, post-secondary certificate, bachelor's degree, masters' degree or higher qualification is statistically significantly different. The same applies to the number of Science and Mathematics teachers who have no degree, a degree in Mathematics only, degree in Science only, and degree in both Science and Mathematics: (χ^2 (1, 1288) = 1735,677, p < ,05).

The difference between the number of Science and Mathematics teachers who have a teaching licence and those who do not have one is also statistically significant: (χ^2 (1, 1288) = 818,914, p <,05). Finally, the one-way chi-square statistical results for the number of Science and Mathematics teachers who have different years of teaching experience is statistically significantly different:
(χ^2 (4, 1277) = 220,537, p < ,05).

Table 7: Summary of the general characteristics of Science and Mathematics teachers

	Teacher Characteristics	Categories	No. of respondents	χ^2	p-value	Significant difference
Science and Mathematics teachers who participated in SITES 2006	Access to a computer at home	Yes	629	25.563[a]	,000	Yes
		No	462			
	Age group	>25	37	1026,404	,000	Yes
		25 - 29	155			
		30 - 39	516			
		40 - 49	404			
		50 - 59	110			
		60+	16			
	Gender	Male	572	7,885	,005	Yes
		Female	671			
	Level of education	Sec / High school	39	720,871	,000	Yes
		Post-sec	677			
		Bachelor's degree	353			
		Master's degree or higher	184			

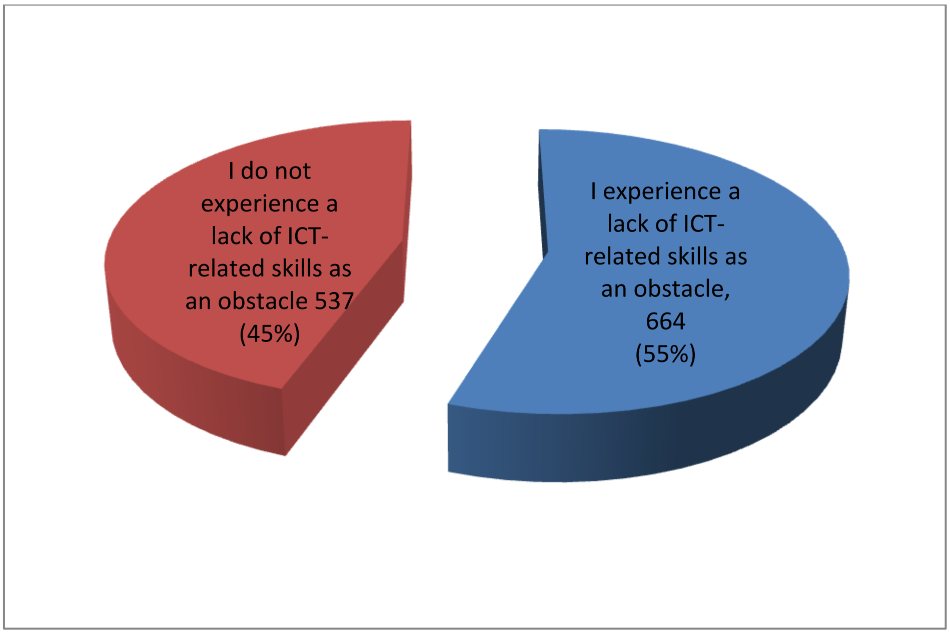
Table 7: Summary of the general characteristics of Science and Mathematics teachers (continued)

<table>
<tr><th></th><th>Teacher Characteristics</th><th>Categories</th><th>No. of respondents</th><th>χ^2</th><th>p-value</th><th>Significant difference</th></tr>
<tr><td rowspan="11">Science and Mathematics teachers who participated in SITES 2006</td><td rowspan="4">Bachelor's degree</td><td>No degree</td><td>957</td><td rowspan="4">1735,677</td><td rowspan="4">,000</td><td rowspan="4">Yes</td></tr>
<tr><td>Degree in Mathematics only</td><td>83</td></tr>
<tr><td>Degree in Science only</td><td>118</td></tr>
<tr><td>Degree in both Mathematics and Science</td><td>106</td></tr>
<tr><td rowspan="2">Teaching licence</td><td>Yes</td><td>1140</td><td rowspan="2">818,914</td><td rowspan="2">,000</td><td rowspan="2">Yes</td></tr>
<tr><td>No</td><td>123</td></tr>
<tr><td rowspan="5">Years of teaching experience</td><td>>2 years</td><td>136</td><td rowspan="5">220,537</td><td rowspan="5">,000</td><td rowspan="5">Yes</td></tr>
<tr><td>2 - 4 years</td><td>233</td></tr>
<tr><td>5 - 9 years</td><td>259</td></tr>
<tr><td>10 - 19 years</td><td>451</td></tr>
<tr><td>20 years +</td><td>198</td></tr>
</table>

4.3 Science and Mathematics teachers who experience a lack of ICT-related skills as an obstacle

Figure 14 shows that 55% (664) of Science and Mathematics teachers reported that they experience a lack of ICT-related skills as an obstacle in their teaching. Only 45% (537) of the teachers do not experience a lack of ICT-related skills as an obstacle (See Addendum A 8). There is a statistically significant difference between the number of Science and Mathematics teachers that experience a lack of ICT-related skills as an obstacle in their teaching and those who do not experience it as an obstacle: (χ^2 (1, 1201) = 13,430, p < ,05) (See Addendum A 8. 1). There are 664 Science and Mathematics teachers who experience a lack of ICT-related skills as an obstacle in their teaching.

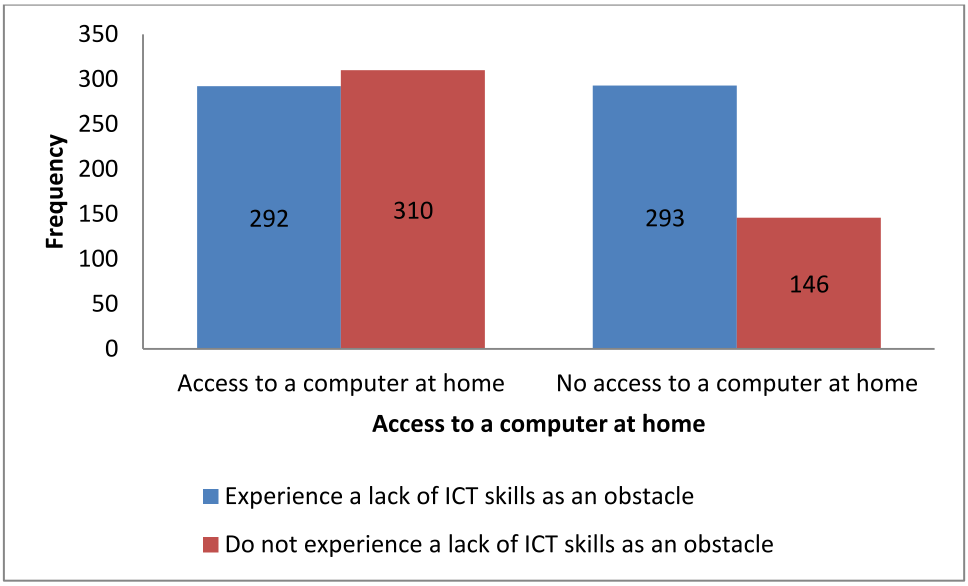
Figure 14: A lack of ICT-related skills as an obstacle in using ICT in teaching of Science and Mathematics teachers



4.3.1 Access to a computer at home of Science and Mathematics teachers who experience a lack of ICT-related skills as an obstacle

Figure 15 shows that 292 (49%) teachers experience a lack of ICT-related skills as an obstacle; yet they have access to a computer at home. On the other hand there are 293 (67%) teachers who do not have access to a computer at home who experience a lack of ICT-related skills as an obstacle (See Addendum A 9). The two way chi-square statistical results show that there is a statistically significant difference between the number of teachers who experience a lack of ICT-related skills as an obstacle and those who do not, relative to whether they have access to a computer at home or not: (χ^2 (1, 1041) = 34,303, $p <$,05) (See Addendum A 9. 1). Probability calculations show that teachers who do not have access to a computer at home are more likely (P (A) = ,28) to experience a lack of related skills as an obstacle as opposed to teachers who have access to a computer at home (P (A) = ,30) (See Addendum A 9. 2).

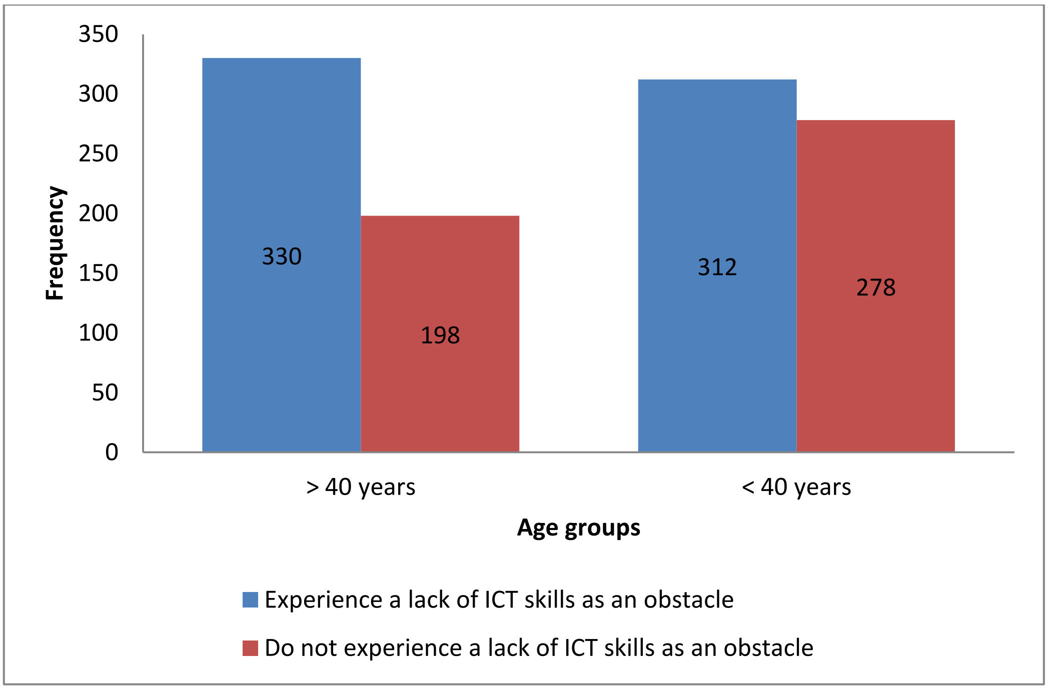
Figure 15: Access to a computer at home of Science and Mathematics teachers who experience a lack of ICT-related skills as an obstacle



4.3.2 Age groups of Science and Mathematics teachers who experience a lack of ICT-related skills as an obstacle

Figure 16 shows that there are 343 (52%) teachers aged under 40 years of age and 312 (61%) teachers who are over the age of 40 years who experience a lack of ICT-related skills as an obstacle (See Addendum A 10). On the contrary there are 330 (58%) teachers under the age of 40 years and 198 (39%) teachers over the age of 40 years who do not experience a lack of ICT-related skills as an obstacle.

Figure 16: Age groups of Science and Mathematics teachers who experience a lack of ICT-related skills as an obstacle

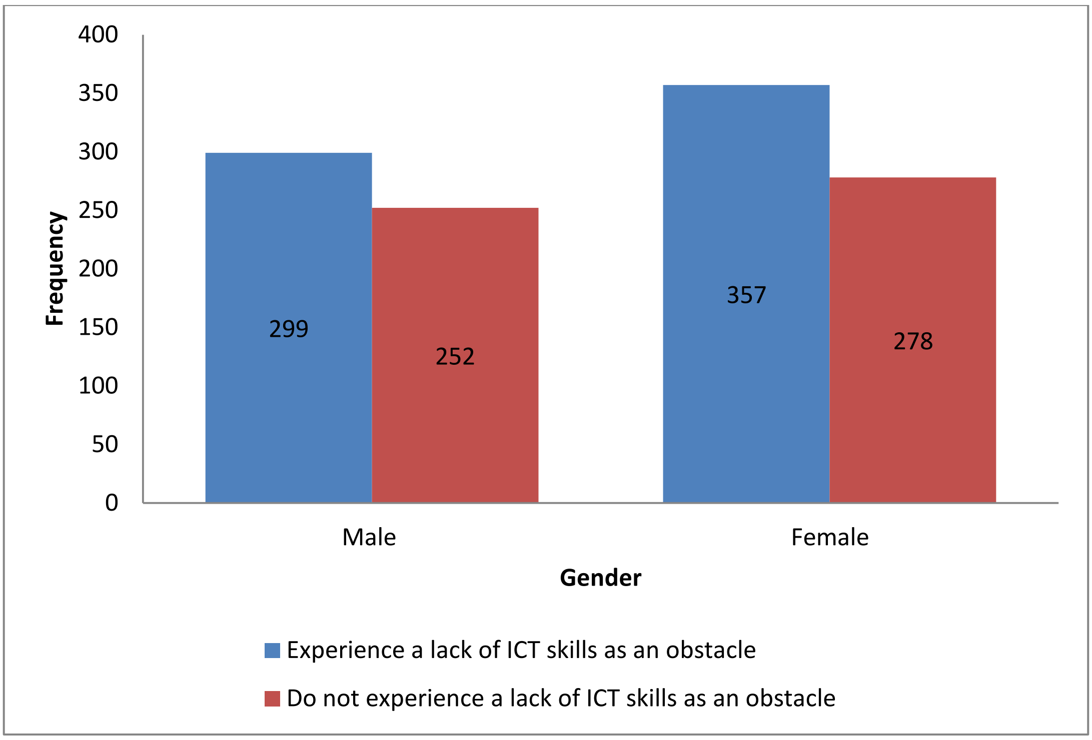


There is a statistically significant difference between the number of teachers who experience a lack of ICT-related skills as an obstacle and those who do not, relative to their various age groups: (χ^2 (1, 1183) = 12,241, p < ,05) (See Addendum A 10.1). Probability calculations show that teachers who are aged under 40 years (P (A) = ,29) are more likely to experience a lack of related skills as an obstacle than teachers who are aged over 40 years (P (A) = ,26) (See Addendum A 10.2).

4.3.3 Gender distribution of Science and Mathematics teachers who experience a lack of ICT-related skills as an obstacle

In terms of gender as shown in Figure 17, it was established that more females (54%) (357) experience a lack of ICT-related skills as an obstacle in their teaching than males (46%) (299). It should be noted, however, that these results do not mean that there are more females who experience a lack of ICT-related skills as an obstacle in their teaching than male teachers when teaching Science and Mathematics. This is because this percentage reflects that more female teachers (54%) participated in the survey than male teachers (46%). This suggests that gender is not an important indicator in experiencing a lack of ICT-related skills as an obstacle (See Addendum A 11). The two-way chi-square statistic results have revealed that the difference between the number of males and females teaching Science and Mathematics who experience a lack of ICT-related skills as an obstacle in their teaching and those who do not experience it as an obstacle is not statistically significant: (χ^2 (1, 1186) = 456, p = ,499) (See Addendum A 11.1). Gender wise there are 357 females and 299 males who experience a lack of ICT-related skills as an obstacle.

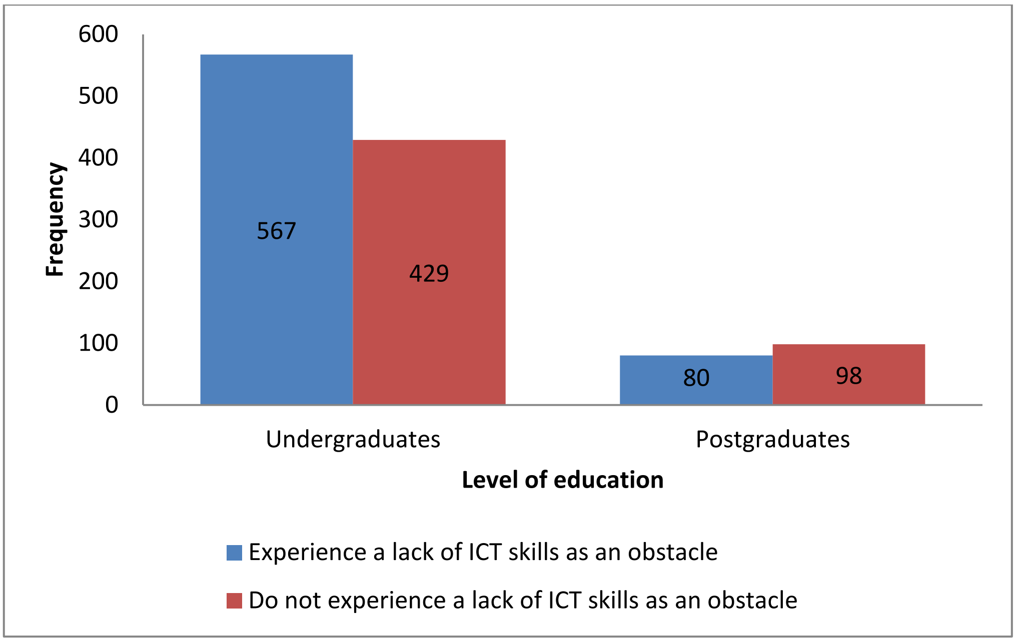
Figure 17: Gender distribution of Science and Mathematics teachers who experience a lack of ICT-related skills as an obstacle



4.3.4 Level of education of Science and Mathematics teachers who experience a lack of ICT-related skills as an obstacle

Figure 18 shows the proportion of South African Science and Mathematics teachers who experience a lack of ICT-related skills as an obstacle, relative to their highest level of education (See Addendum A 12). The two-way chi-square statistics results have revealed that there is a statistical significant difference between the number of undergraduate and postgraduate Science and Mathematics teachers who experience a lack of ICT-related skills as an obstacle in their teaching and those who do not experience it as an obstacle: (χ^2 (1, 1174) = 8,767, p < ,05) (See Addendum A 12.1). Probability calculations show that undergraduates are more likely (P (A) = ,48) to experience a lack of related skills as an obstacle as opposed to postgraduates (P (A) = ,07) (See Addendum A 12.2).

Figure 18: Level of education of Science and Mathematics teachers who experience a lack of ICT-related skills as an obstacle



4.3.5 Bachelor's degree obtained by Science and Mathematics teachers who experience a lack of ICT-related skills as an obstacle

The number of teachers who experience the problem of a lack ICT-related skills as an obstacle among South African Science and Mathematics teachers is greatest for those teachers who do not have a degree in either Mathematics or Science (See Addendum A 13).

Figure 19: Bachelor's degree obtained by Science and Mathematics teachers who experience a lack of ICT-related skills as an obstacle

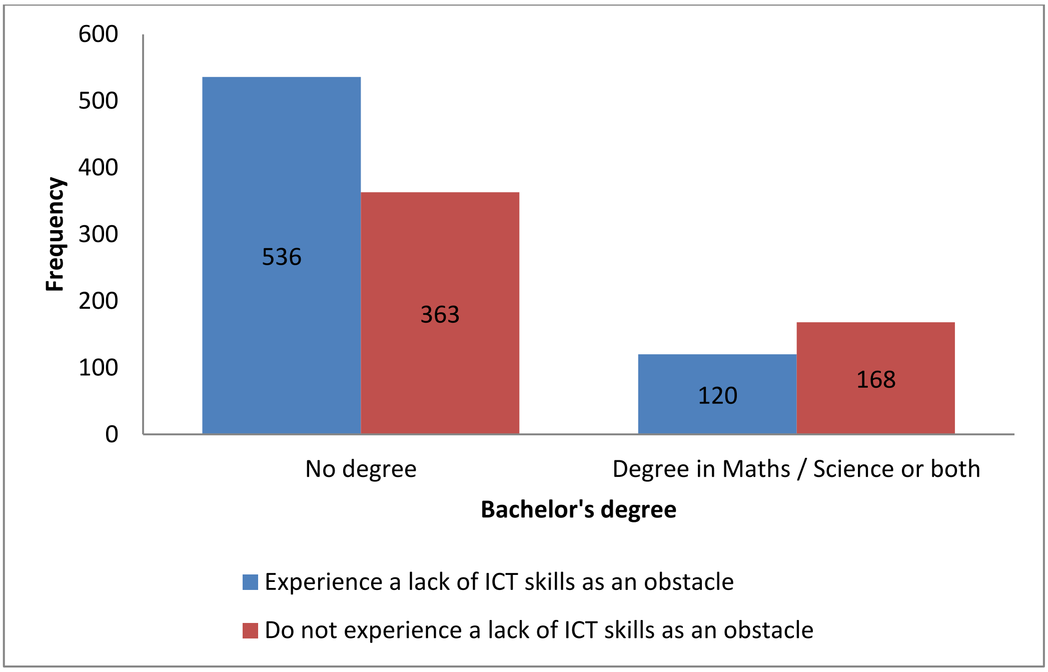
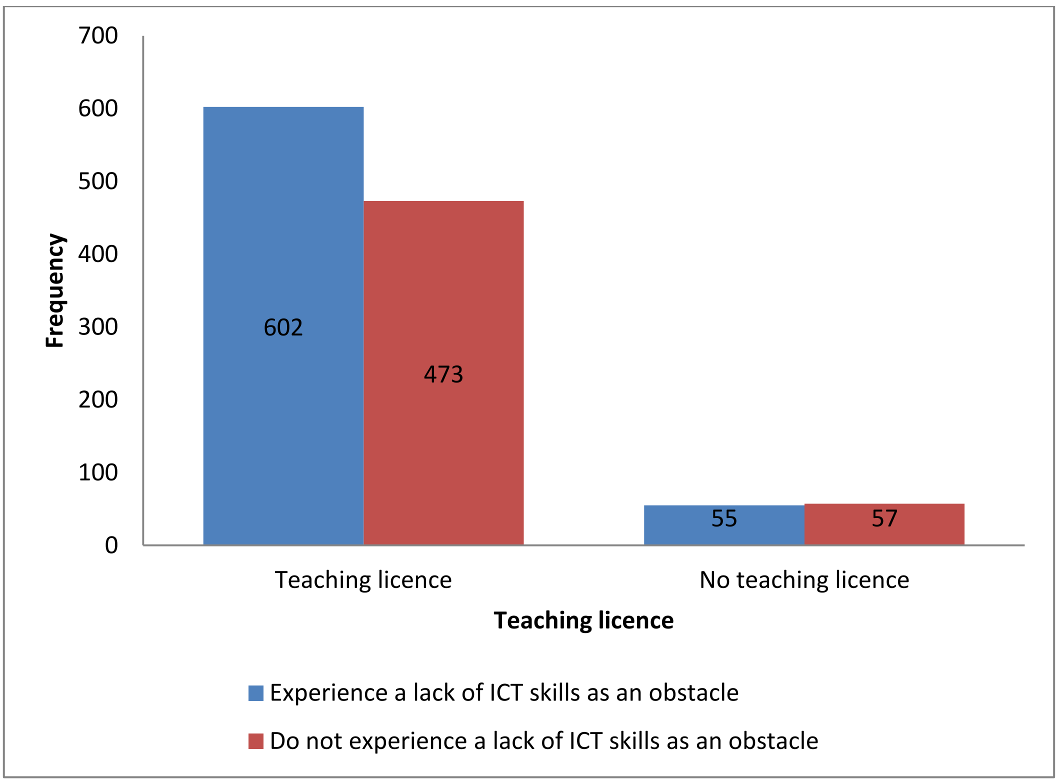


Figure 19 shows that 60% (536) teachers who do not have a degree in Science or Mathematics experience the problem of a lack of ICT-related skills as an obstacle. On the other hand, only 40% (120) teachers who have a degree in both Science and Mathematics experience the problem of a lack of ICT-related skills as an obstacle (See Addendum A 13). The two-way chi-square statistics results have revealed that there is a statistical significant difference between the number of Science and Mathematics teachers who experience a lack of ICT-related skills as an obstacle in their teaching and those who do not experience it as an obstacle, relative to whether they have a degree in Mathematics / Science or not:
(χ^2 (1, 1187) = 28,443, p < ,05) (See Addendum A 13.1). Probability calculations also confirm that Science and Mathematics teachers who do not have a degree in either Science or Mathematics are more likely (P (A) = ,45) to experience the problem of a lack of ICT-related skills as an obstacle as opposed to those who have a degree in Science or Mathematics or both (P (A) = ,10) (See Addendum A 13.2).

4.3.6 Teaching licence or certificate obtained by Science and Mathematics teachers who experience a lack of ICT-related skills as an obstacle

Figure 20 indicates that a teaching licence does not seem to have enabled Science and Mathematics teachers to acquire the required ICT-related skills. This is because 92% (602) of the South African Science and Mathematics teachers who have a teaching licence experience the problem of a lack of ICT-related skills as an obstacle (See Addendum A 14).

Figure 20: Science and Mathematics teachers who experience the problem of a lack of ICT-related skills as an obstacle relative to whether they have a teaching licence / certificate or not

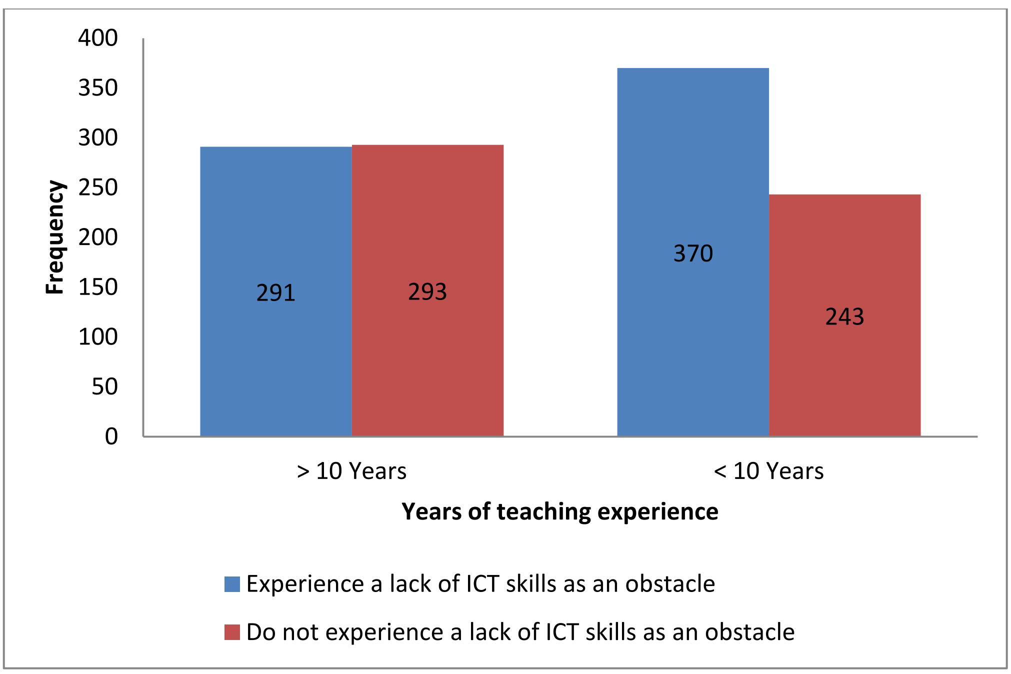


The two-way chi-square statistics results have revealed that the difference between the number of South African Science and Mathematics teachers who experience the problem of a lack of ICT-related skills as an obstacle, relative to whether they have a teaching licence / certificate or not is not statistically different: (χ^2 (1, 1187) = 1,950, p = ,163) (See addendum A 14.1). The probability calculations also confirm that possessing a teaching licence or certificate is not an important predictor of whether one will experience the problem of a lack of ICT-related skills as an obstacle or not. This is because teachers with a teaching licence have a higher (P (A) = ,51) probability of experiencing the problem of a lack of ICT-related skills as an obstacle (P (A) = ,05) (See addendum A 14.2).

4.3.7 Years of teaching experience of Science and Mathematics teachers who experience a lack of ICT-related skills as an obstacle

Figure 21 shows that 291 (50%) teachers who have less than ten years' teaching experience and 370 (60%) teachers who have taught for more than ten years, experience a lack of ICT-related skills as an obstacle. On the other hand 293 (50%) teachers with less than ten years' teaching experience and 243 (40%) teachers who have more than ten years teaching' experience do not experience a lack of ICT-related skills as an obstacle (See Addendum A 15).

Figure 21: Years of teaching experience of Science and Mathematics teachers who experience a lack of ICT-related skills as an obstacle



The two-way statistical results indicate that there is a statistically significant difference between the number of teachers who experience a lack of ICT-related skills as an obstacle and those who do not, relative to their years of teaching experience:
(χ^2 (1, 1197) = 13,411, p < ,05) (See Addendum A 15.1). Probability calculations show that teachers with less than ten years' teaching experience are more likely (P (A) = ,31) to experience a lack of related skills as an obstacle as opposed to teachers with more than ten years' teaching experience (P (A) = ,25) (See Addendum A 15.2).

4.3.8 Summary

The summary shown in Table 8 indicates that there is a statistically significant difference between the number of Science and Mathematics teachers who experience a lack of ICT-related skills as an obstacle in their teaching and those who do not experience it as an obstacle: (χ^2 (1, 1201) = 13,430, p < ,05).

Table 8: Summary of Science and Mathematics teachers who experience a lack of ICT-related skills as an obstacle in using ICT

South African Science and Mathematics teachers experiencing obstacles to ICT-related skills

Teacher characteristics	Category / Number of respondents			χ^2	p-value	Significant difference
Experience a lack of ICT-related skills as an obstacle		Yes	No			
		664	537	13,430	,000	Yes
Access to a computer at home	Yes	292	310	34,303	,000	Yes
	No	293	146			
Age groups	> 40	343	330	12,241	,000	Yes
	< 40	312	198			
Gender	Male	299	252	,456	,499	No
	Female	357	278			
Level of education	Undergraduates	567	429	8,767	,0003	Yes
	Post-graduates	80	98			
Bachelor's Degree	No degree	536	363	28,443	,000	Yes
	Degree in Science / Maths or both	120	168			
Teaching licence	Yes	602	473	1,950	,163	No
	No	55	57			
Years of teaching experience	> 10	291	293	13,411	,000	Yes
	< 10	370	243			

To determine the statistical significant difference between the number of teachers who experience a lack of ICT-related skills as an obstacle and those who do not, other moderator variables such as access to a computer at home, age groups, gender, level of education, a bachelor's degree, teaching licence and years of teaching experience were used. The two-way chi-square statistical results reveal that (1) the number of Science and Mathematics teachers who have access to a computer at home and those who do not have such access is statistically significantly different: (χ^2 (1, 101) = 34,303, p < ,05); (2) the number of teachers who are under 40 years of age and those who are over 40 years of age is statistically significantly different: (χ^2 (1, 1183) = 12,241, p < ,05); (3) the number of male and female Science and Mathematics teachers is not statistically significantly different: (χ^2 (1, 1186) = ,456, p = ,499); (4) the number of undergraduate and post-graduate Science and Mathematics teachers is statistically significantly different: (χ^2 (1, 1174) = 8,767, p < ,05); (5) the difference between the number of teachers who have no degree and those who have one in Mathematics, Science or both is statistically significant: (χ^2 (1, 1187) = 28,443, p < ,05); (6) there is no statistically significant difference between the number of teachers who have a teaching licence and those who do not have one: (χ^2 (1, 1187) = 1,950, p = ,163) and (7) there is a statistically significant difference between the number of teachers with less than ten years' teaching experience and those with more than ten years' teaching experience: (χ^2 (1, 1197) = 13,411, p < ,05).

4.4 South African Science and Mathematics teachers' participation in an introductory course in Internet use and general applications and their willingness to attend

Table 9 shows that 13% (87) of the Science and Mathematics teachers who experience the problem of a lack of ICT-related skills as an obstacle reported to have participated in an introductory course in Internet use and general applications. However, most (84%) (546) teachers are willing to attend such a course if available. Only 3% (20) of the teachers who experience the problem of a lack of ICT-related skills as an obstacle reported that they do not wish to attend an introductory course in Internet use and general applications to improve their ICT skills (See Addendum A 16).

Table 9: Science and Mathematics teachers' participation in an introductory course in Internet use and general applications and their willingness to attend

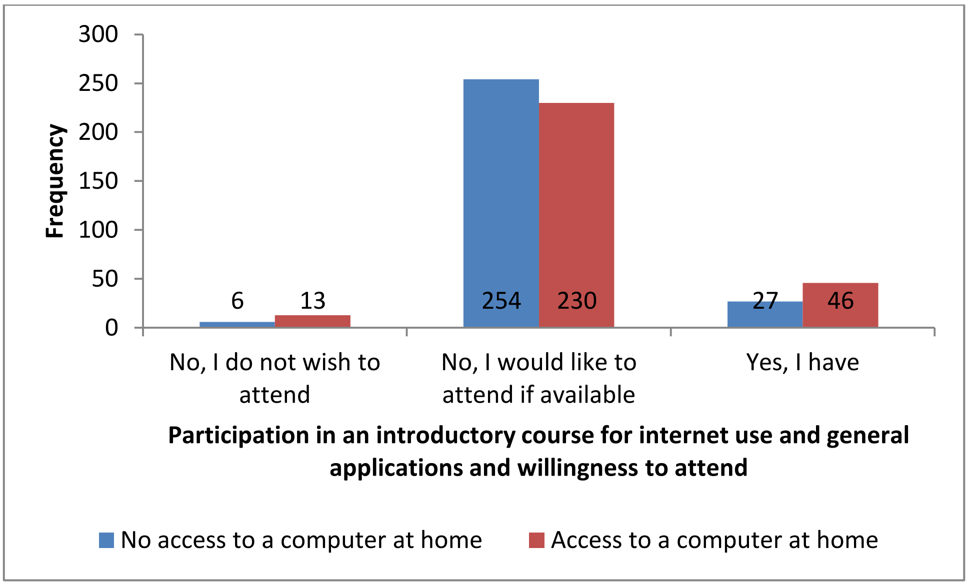
	Frequency	Percentage (%)
No, I do not wish to attend	20	3.1
No, I would like to attend if available	546	83.6
Yes, I have attended	87	13.3
Total	**653**	**100**
Chi-square		753.210[a]
df		2
Asymp. Sig.		.000

There is a statistically significant difference between the number of Science and Mathematics teachers who have participated in an introductory course in Internet use and general applications who are willing to attend if available and those who do not wish to attend: (χ^2 (2, 653) = 753,210, p < ,05) (See Addendum A 16.1).

4.4.1 Access to a computer for South African Science and Mathematics teachers who participated in an introductory course in Internet use and general applications and their willingness to attend

Figure 22 indicates that there are 254 (89%) teachers who do not have access to a computer at home and 230 (80%) teachers who have such access who have not participated in an introductory course in Internet and general applications who are willing to attend. Only 6 (2%) teachers who have no access to a computer at home and 13 (4%) teachers who have access to a computer at home are not willing to attend a course in Internet use and general applications despite the fact that they experience a lack of ICT-related skills as an obstacle. There are 27 (9%) teachers who have no access to a computer at home and 46 (16%) teachers who have access to one who have participated in an introductory course in Internet and general applications (See Addendum A 17). The two-way chi-square test results reveal that there is a statistically significant difference between the number of teachers who are not willing to attend, who are willing to attend and those who have already attended a course in Internet use and general applications, relative to whether they have access to a computer at home or not: (χ^2 (2, 576) = 8,707, p < ,05) (See Addendum A 17.1).

Figure 22: Access to a computer of South African Science and Mathematics teachers who participated in an introductory course in Internet use and general applications and their willingness to attend

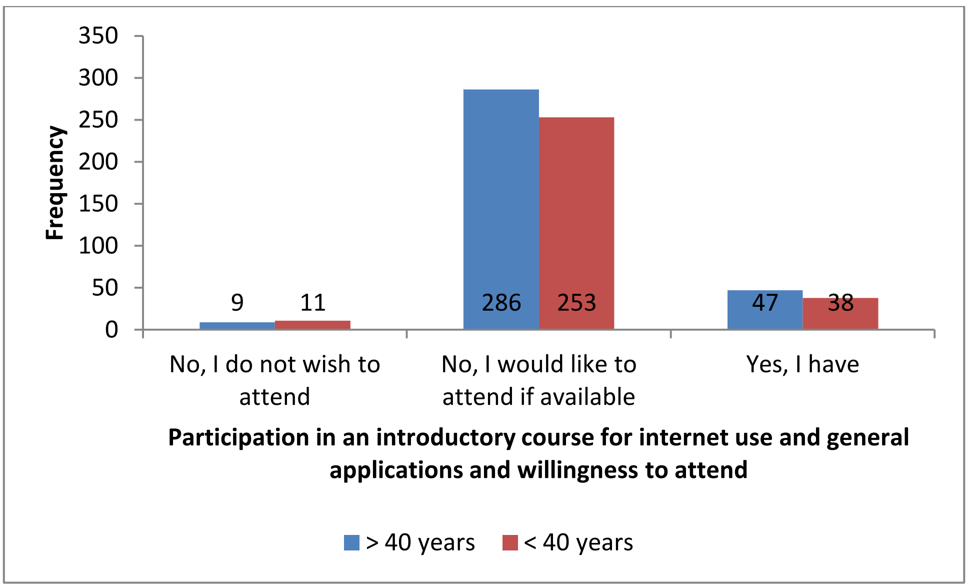


4.4.2 Age groups of South African Science and Mathematics teachers who participated in an introductory course in Internet use and general applications and their willingness to attend

Figure 23 shows that 286 (84%) teachers who are under forty years of age and 253 (84%) teachers who are over forty years of age who have not participated in an introductory course in Internet and general applications are willing to attend. Only 9 (3%) teachers who are under the age of 40 and 11 (4%) teachers who are over the age of 40 years are not willing to attend. There are 47 (14%) teachers who are under the age of 40 and 38 (13%) teachers who are over the age of 40 years who have participated in an introductory course in Internet and general applications (See Addendum A 18).

The two-way chi-square test results reveal that the difference between the number of teachers who are not willing to attend, who are willing to attend and those who have already attended a course in Internet use and general applications, relative to whether they are under or over 40 years of age, is not statistically significant: (χ^2 (2, 644) =, 692, p =, 708) (See Addendum A 18.1).

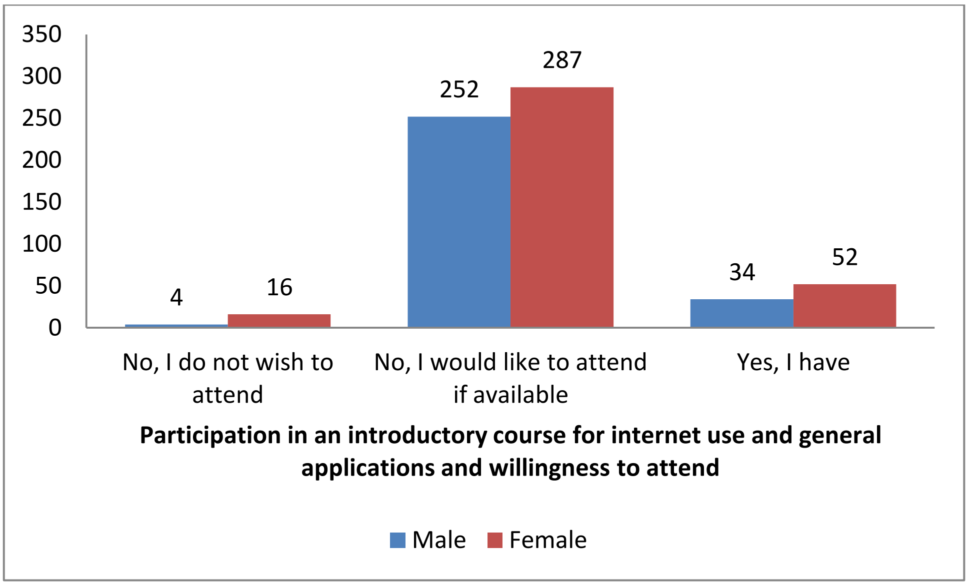
Figure 23: Age groups of South African Science and Mathematics teachers who participated in an introductory course in Internet use and general applications and their willingness to attend



4.4.3 Gender distribution of South African Science and Mathematics teachers who participated in an introductory course in Internet use and general applications and their willingness to attend

Figure 24 shows that there are 287 (81%) female teachers and 252 (87%) male teachers who have not participated in an introductory course in Internet and general applications who are willing to attend. However, there are 16 (5%) female and 4 (1%) male teachers who are not willing to attend. There are only 52 (15%) female and 34 (12%) male teachers who have attended an introductory course in Internet and general applications (See Addendum A 19). There is a statistically significant difference between the number of teachers who are not willing to attend, who are willing to attend and those who have already attended a course in Internet use and general applications relative to whether they are male or female: (χ^2 (2, 645) = 6,758, p < ,05) (See Addendum A 19.1).

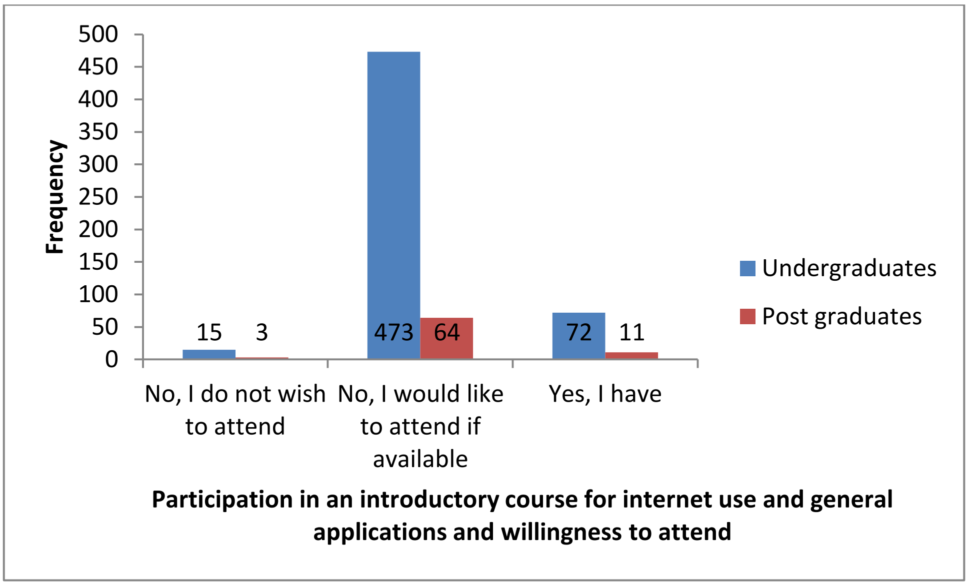
Figure 24: Gender distribution of South African Science and Mathematics teachers who participated in an introductory course in Internet use and general applications and their willingness to attend



4.4.4 Level of education of South African Science and Mathematics teachers who participated in an introductory course in Internet use and general applications and their willingness to attend

Figure 25 shows that there are 473 (84%) undergraduates and 64 (82%) post-graduates who have not participated in an introductory course in Internet and general applications who are willing to attend. On the contrary, there are 15 (3%) undergraduates and 3 (4%) postgraduates who are not willing to attend an introductory course in Internet and general applications despite the fact that they experience a lack of ICT-related skills as an obstacle. There are 72 (13%) undergraduates and 11 (14%) postgraduates who have participated in an introductory course in Internet and general applications (See Addendum A 20). The difference between the number of teachers who are not willing to attend, who are willing to attend and those who have already attended a course in Internet use and general applications, relative to whether they are undergraduates or postgraduates is not statistically significant: (χ^2 (2, 638) = 0,460, p = ,795) (See Addendum A 20.1).

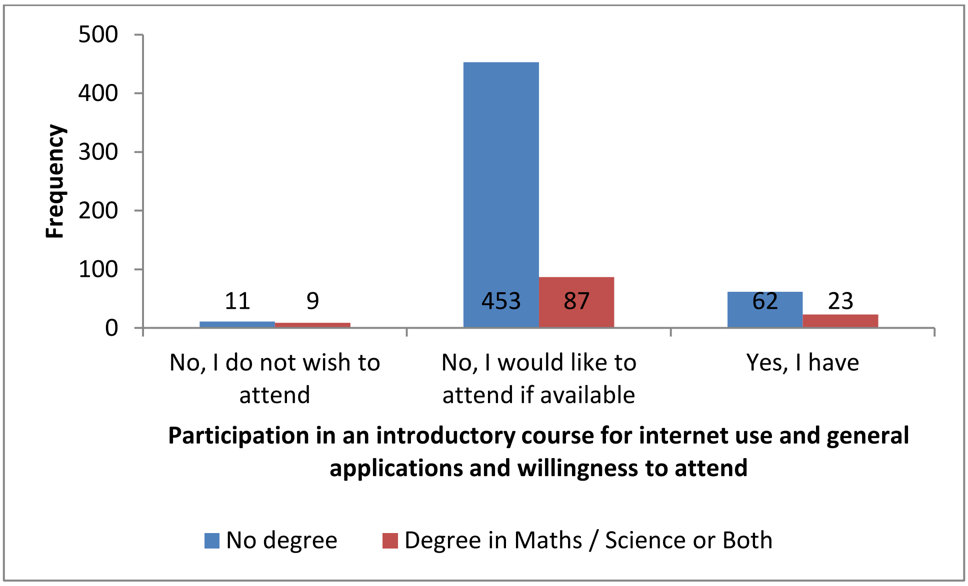
Figure 25: Level of education of South African Science and Mathematics teachers who participated in an introductory course in Internet use and general applications and their willingness to attend



4.4.5 Bachelor's degree obtained by South African Science and Mathematics teachers who participated in an introductory course in Internet use and general applications and their willingness to attend

Figure 26 shows that there are 453 (86%) teachers who do not have a degree and 87 (73%) teachers who have a degree in Mathematics, or Science or both who have not participated in an introductory course in Internet and general applications who are willing to attend. On the other hand, there are 11 (2%) teachers with no degree and 9 (8%) teachers with a degree in Science or Mathematics or both who are not willing to attend, despite the fact that they experience a lack of ICT-related skills as an obstacle. There are only 62 (12%) teachers with no degree and 23 (19%) teachers with a degree in Science or Mathematics or both who have participated in an introductory course in Internet and general applications (See Addendum A 21).

Figure 26: Bachelor's degree obtained by South African Science and Mathematics teachers who participated in an introductory course in Internet use and general applications and their willingness to attend

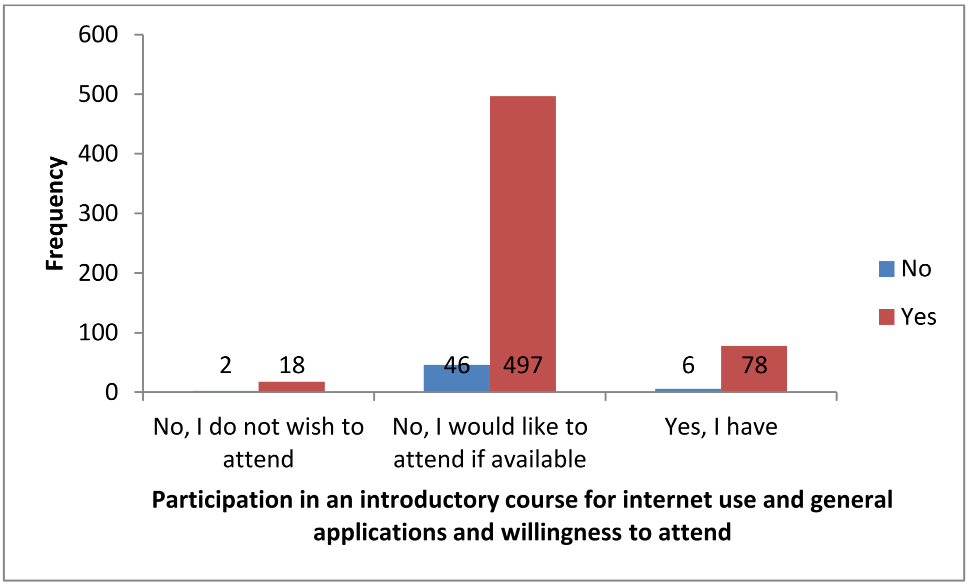


There is a statistically significant difference between the number of teachers who are not willing to attend, who are willing to attend and those who have already attended a course in Internet use and general applications, relative to whether they have a degree or no degree in Mathematics or Science or both:
(χ^2 (2, 645) = 15,520, p < ,05) (See Addendum A 21.1).

4.4.6 Teaching licence or certificate obtained by South African Science and Mathematics teachers who participated in an introductory course in Internet use and general applications and their willingness to attend

Figure 27 shows that there are 46 (85%) teachers who do not have a teaching licence and 497 (84%) teachers who have a teaching licence who have not participated in an introductory course in Internet and general applications who are willing to attend.

Figure 27: Teaching licence or certificate obtained by South African Science and Mathematics teachers who participated in an introductory course in Internet use and general applications and their willingness to attend

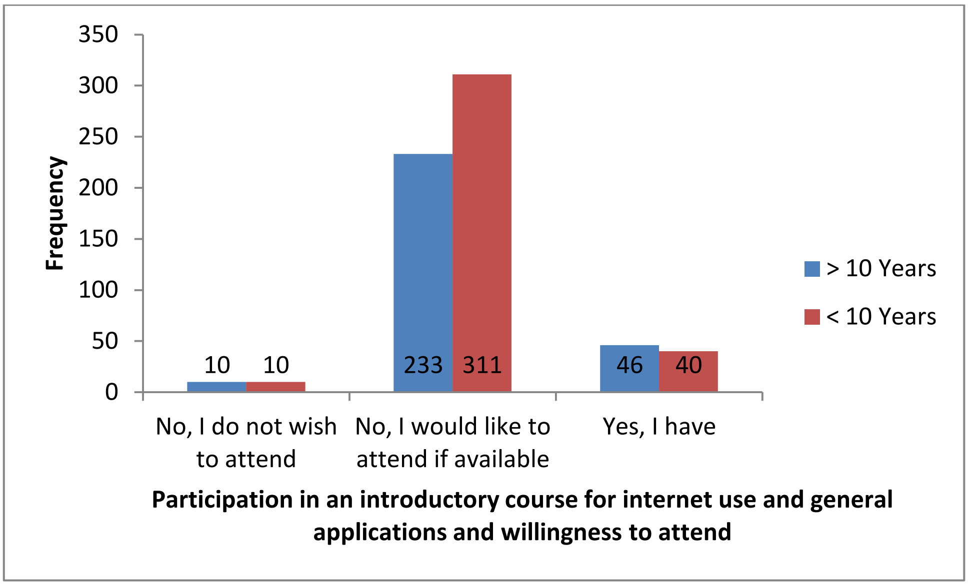


However, there are 2 (4%) teachers with no teaching licence and 18 (37%) teachers with a teaching licence who are not willing to attend despite the fact that they experience a lack of ICT-related skills as an obstacle. There are only 6 (11%) teachers with no teaching licence and 78 (13%) teachers with a teaching licence who have participated in an introductory course in Internet and general applications (See Addendum A 22). The difference between the number of teachers who are not willing to attend, who are willing to attend and those who have already attended a course in Internet use and general applications, relative to whether they have a teaching licence or not is not statistically significantly different: (χ^2 (2, 647) = 0,242, p = ,886) (See Addendum A 22.1).

4.4.7 Years of teaching experience of South African Science and Mathematics teachers who participated in an introductory course in Internet use and general applications and their willingness to attend

Figure 28 shows that there are 233 (81%) teachers who have less than ten years' teaching experience and 311 (86%) teachers who have more than ten years' teaching experience who have not participated in an introductory course in Internet and general applications who are willing to attend.

Figure 28: Years of teaching experience of South African Science and Mathematics teachers who participated in an introductory course in Internet use and general applications and their willingness to attend



There are 10 (35%) teachers who have less than ten years' teaching experience and 10 (28%) teachers who have more than ten years' teaching experience who are not willing to attend despite the fact that they experience a lack of ICT-related skills as an obstacle. There are only 46 (52%) teachers who have less than ten years' teaching experience and 40 (11%) teachers who have more than ten years' teaching experience who have participated in an introductory course in Internet and general applications (See Addendum A 23). There is a statistically significant difference between the number of teachers who are not willing to attend, who are willing to attend and those who have already attended a course in Internet use and general applications relative to whether they have less or more than ten years' teaching experience: (χ^2 (2, 650) = 3,672, p = ,159) (See Addendum A 23.1).

4.4.8 Science and Mathematics teachers' participation in an advanced course in applications / standard tools and their willingness to attend

Table 10 shows that 4.4% (29) of the Science and Mathematics teachers who experience the problem of a lack of ICT-related skills as an obstacle have participated in an advanced course in applications / standard tools. However, on the positive side 88% (585) of teachers are willing to attend an advanced course in applications / standard tools if available. Only 6.5% (43) of the Science and Mathematics teachers who experience the problem of a lack of ICT-related skills as an obstacle are not willing to attend and advanced course in applications / standard tools if available (See Addendum A 24). There is a statistically significant difference between the number of Science and Mathematics teachers who have participated in an advanced course in applications / standard tools who are willing to attend if available and those who do not wish to attend: (χ^2 (2, 657) = 917,954, p < ,05) (See Addendum A 24.1).

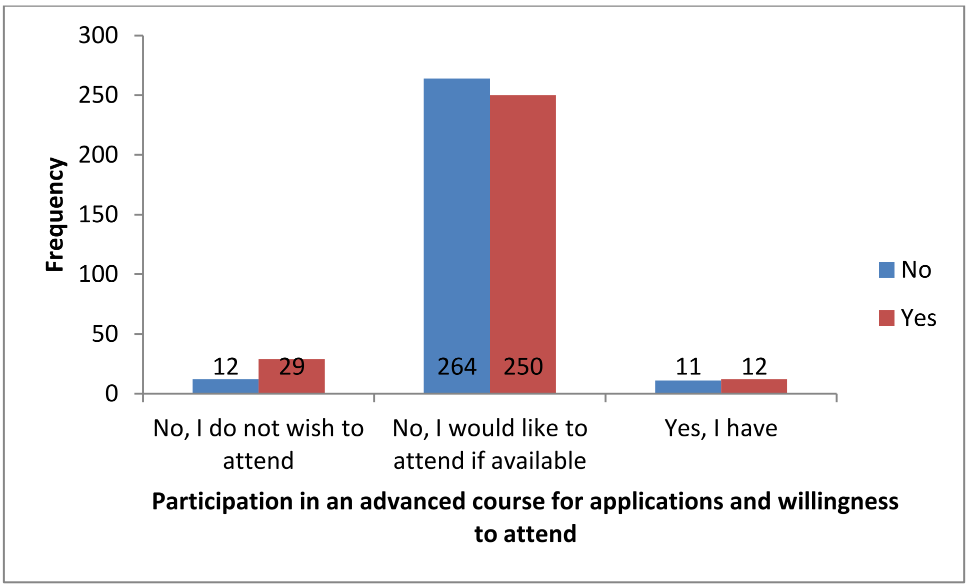
Table 10: Science and Mathematics teachers' participation in an advanced course in applications / standard tools and their willingness to attend

	Frequency	Percentage (%)
No, I do not wish to attend	43	6.5
No, I would like to attend if available	585	88.1
Yes, I have attended	29	4.4
Total	**657**	**100**
Chi-square		917,954
df		2
Asymp. Sig.		,000

4.4.9 Access to a computer at home of South African Science and Mathematics teachers who participated in an advanced course in applications / standard tools and their willingness to attend

Figure 29 indicates that there are 264 (92%) teachers who do not have access to a computer at home and 250 (86%) teachers who do have access who have not participated in an advanced course in applications / standard tools who are willing to attend.

Figure 29: Access to a computer at home of South African Science and Mathematics teachers who participated in an advanced course in applications / standard tools and their willingness to attend

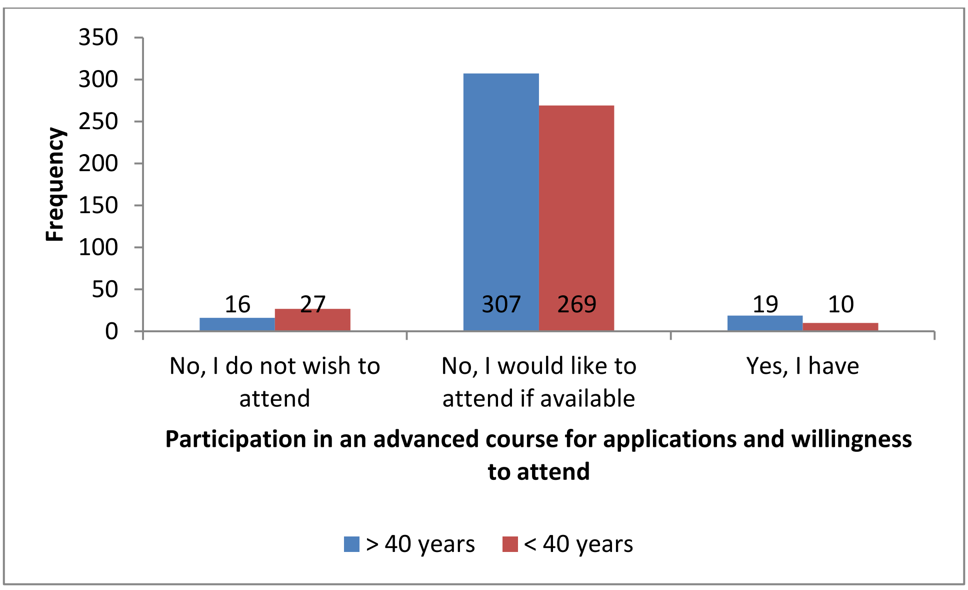


Only 12 (4%) teachers who have no access to a computer at home and 29 (10%) teachers who have such access are not willing to attend an advanced course in applications / standard tools, despite the fact that they experience a lack of ICT-related skills as an obstacle. There are 11 (4%) teachers who have no access to a computer at home and 12 (4%) teachers who have such access who have participated in an advanced course in applications / standard tools (See Addendum A 25). The two-way chi-square test results reveal that there is a statistically significant difference between the number of teachers who are not willing to attend, who are willing to attend and those who have already attended an advanced course in applications / standard tools, relative to whether they have an access to a computer at home or not: (χ^2 (2, 578) = 7,446, p < ,05) (See Addendum A 25.1).

4.4.10 Age groups of South African Science and Mathematics teachers who participated in an advanced course in applications / standard tools and their willingness to attend

Figure 30 shows that 307 (90%) teachers who are under forty years of age and 269 (88%) teachers who are over forty years of age who have not participated in an advanced course in applications / standard tools are willing to attend. Only 16 (5%) teachers who are under the age of 40 and 27 (9%) teachers who are over the age of 40 years are not willing to attend.

Figure 30: Age groups of South African Science and Mathematics teachers who participated in an advanced course in applications / standard tools and their willingness to attend

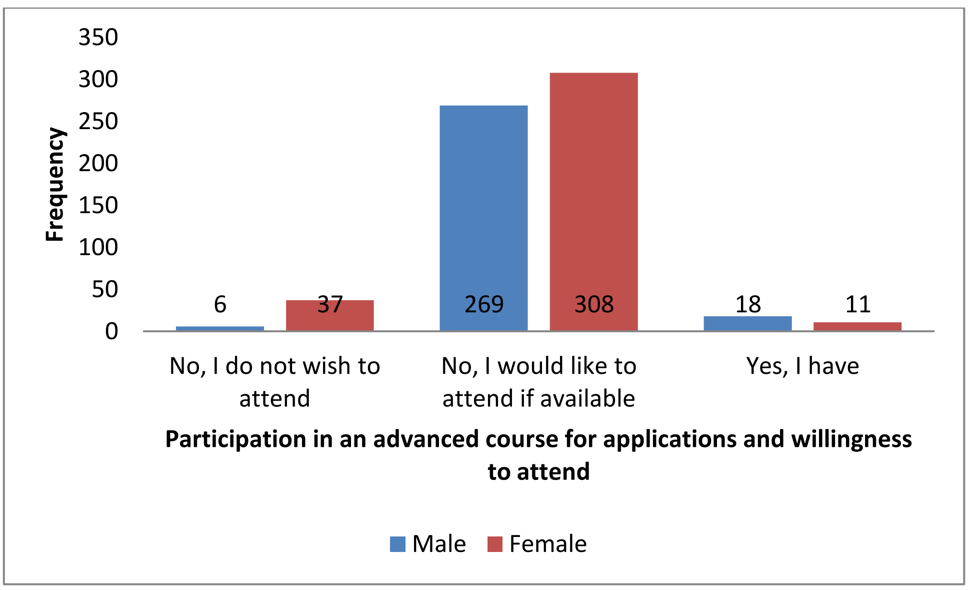


There are 19 (6%) teachers who are under the age of 40 and 10 (3%) teachers who are over the age of 40 who have participated in an advanced course in applications / standard tools (See Addendum A 26). The two-way chi-square test results reveal that there is a statistically significant difference between the number of teachers who are not willing to attend, who are willing to attend and those who have already attended an advanced course in applications / standard tools relative to whether they are below or above 40 years of age: (χ^2 (2, 648) = 6,133, p < ,05) (See Addendum A 26.1).

4.4.11 Gender distribution of South African Science and Mathematics teachers who participated in an advanced course in applications / standard tools and their willingness to attend

Figure 31 shows that there are 308 (87) female teachers and 269 (92%) male teachers who have not participated in an advanced course in applications / standard tools who are willing to attend.

Figure 31: Gender distribution of South African Science and Mathematics teachers who participated in an advanced course in applications / standard tools and their willingness to attend



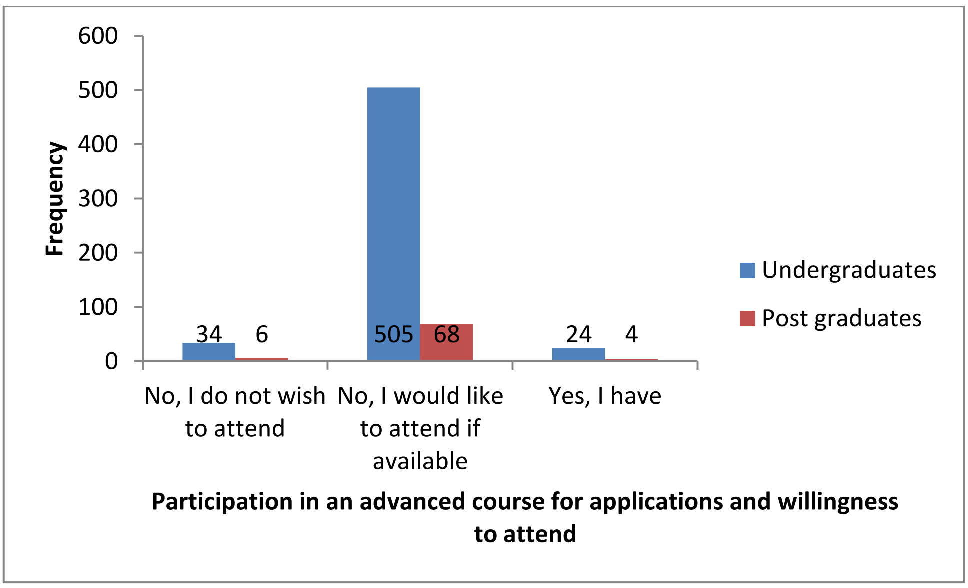
On the other hand, there are 37 (10%) female and 6 (2%) male teachers who are not willing to attend. There are only 11 (3%) female and 18 (6%) male teachers who have attended an advanced course in applications / standard tools (See Addendum

A 27). There is a statistically significant difference between the number of teachers who are not willing to attend, who are willing to attend and those who have already attended an advanced course in applications / standard tools relative to whether they are male or female: (χ^2 (2, 649) = 20,755, p < ,05) (See Addendum A 27.1).

4.4.12 Level of education of South African Science and Mathematics teachers who participated in an advanced course in applications / standard tools and their willingness to attend

Figure 32 shows that there are 505 (90%) undergraduates and 68 (87%) postgraduates who have not participated in advanced course in applications / standard tools who are willing to attend.

Figure 32: Level of education of South African Science and Mathematics teachers who participated in an advanced course in applications / standard tools and their willingness to attend

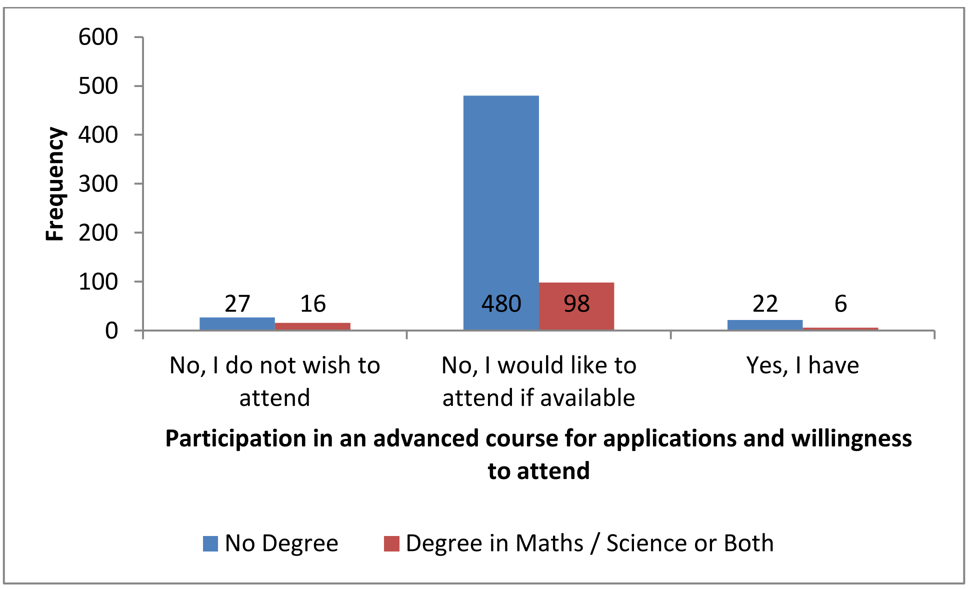


However, there are 34 (6%) undergraduates and 6(8%) postgraduates who are not willing to attend an advanced course in applications / standard tools, despite the fact that they experience a lack of ICT-related skills as an obstacle. There are 24 (4%) undergraduates and 4 (5%) postgraduates who have participated in an advanced course in applications / standard tools (See Addendum A 28). The difference between the number of teachers who are not willing to attend, who are willing to attend and those who have already attended an advanced course in applications / standard tools relative to whether they are undergraduates or postgraduates is not statistically significant: (χ^2 (2, 641) = 0,466, p = ,792) (See Addendum A 28.1).

4.4.13 Bachelor's degree obtained by South African Science and Mathematics teachers who participated in an advanced course in applications / standard tools and their willingness to attend

Figure 33 shows that there are 480 (91%) teachers who do not have a degree and 98 (82%) teachers who have a degree in Mathematics or Science or both who have not participated in an advanced course in applications / standard tools who are willing to attend.

Figure 33: Bachelor's degree obtained by South African Science and Mathematics teachers who participated in an advanced course in applications / standard tools and their willingness to attend

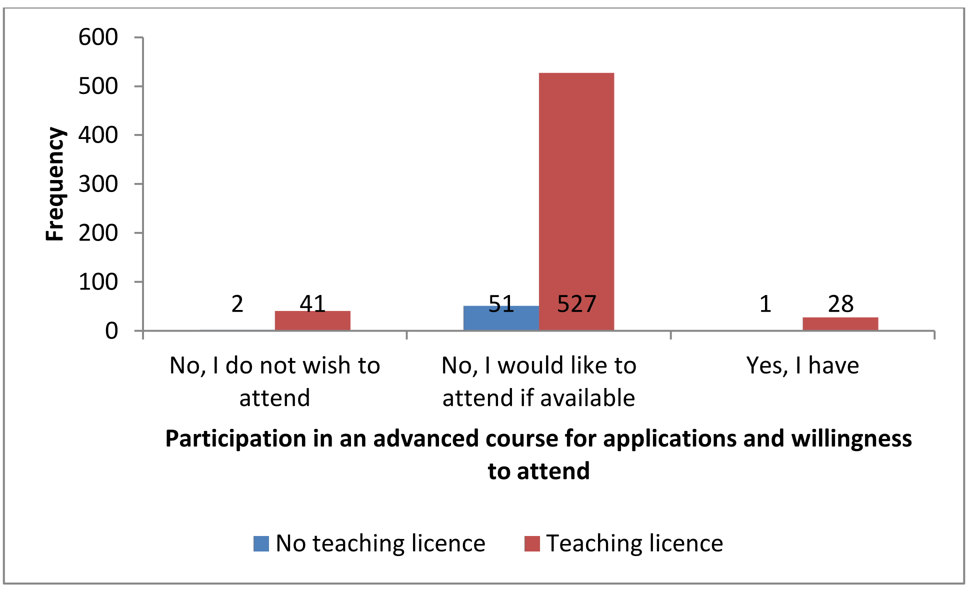


There are 27 (5%) teachers with no degree and 16 (13%) teachers with a degree in Science or Mathematics or both who are not willing to attend, despite the fact that they experience a lack of ICT-related skills as an obstacle. There are only 22 (4%) teachers with no degree and 6 (5%) teachers with a degree in Science or Mathematics or both who have participated in an advanced course in applications / standard tools (See Addendum A 29). There is a statistically significant difference between the number of teachers who are not willing to attend, who are willing to attend and those who have already attended an advanced course in applications / standard tools, relative to whether they have a degree or no degree in Mathematics or Science: (χ^2 (2,649) = 11,062, p < ,05) (See Addendum A 29.1).

4.4.14 Teaching licence or certificate obtained by South African Science and Mathematics teachers who participated in advanced course in applications / standard tools and their willingness to attend

Figure 34 shows that there are 51 (94%) teachers who do not have a teaching licence and 527 (88%) teachers who have a teaching licence who have not participated in an advanced course in applications / standard tools who are willing to attend.

Figure 34: Teaching licence or certificate obtained by South African Science and Mathematics teachers who participated in an advanced course in applications / standard tools and their willingness to attend

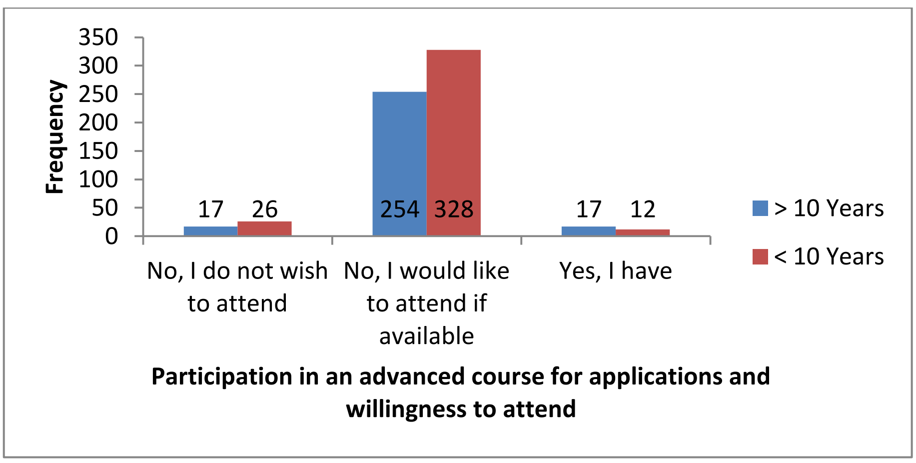


There are 2 (4%) teachers with no teaching licence and 41(7%) teachers with a teaching licence who are not willing to attend, despite the fact that they experience a lack of ICT-related skills as an obstacle. There is only 1 (2%) teacher with no teaching licence and 28 (5%) teachers with a teaching licence who have participated in an advanced course in applications / standard tools (See Addendum A 30). The difference between the number of teachers who are not willing to attend, who are willing to attend and those who have already attended an advanced course in applications / standard tools relative to whether they have a teaching licence or not is not statistically significant: (χ^2 (2, 650) = 1,856, p = ,395) (See Addendum A 30.1).

4.4.15 Years of teaching experience of South African Science and Mathematics teachers who participated in an advanced course in applications / standard tools and their willingness to attend

Figure 35 shows that there are 254 (88%) teachers who have less than ten years' teaching experience and 328 (90%) teachers who have more than ten years' teaching experience who have not participated in an advanced course in applications / standard tools who are willing to attend.

Figure 35: Years of teaching experience of South African Science and Mathematics teachers who participated in an advanced course in applications / standard tools and their willingness to attend



On the other hand, there are 17 (6%) teachers who have less than ten years' teaching experience and 26 (7%) teachers who have more than ten years' teaching experience who are not willing to attend, despite the fact that they experience a lack of ICT-related skills as an obstacle. There are only 17 (6%) teachers who have less than ten years' teaching experience and 12 (3%) teachers who have more than ten years' teaching experience who have participated in an advanced course in applications / standard tools (See Addendum A 31).

The difference between the number of teachers who are not willing to attend, who are willing to attend and those who have already attended an advanced course in applications / standard tools, relative to whether they have more or less than ten years' teaching experience, is not statistically significant:
(χ^2 (2, 654) = 2,893, p = ,235) (See Addendum A 31.1).

4.4.16 Summary

Table 11 shows a summary of South African Science and Mathematics teachers' participation in an introductory course in Internet use and general applications and their willingness to attend. A statistically significant difference was found between the number of Science and Mathematics teachers who have participated in an introductory course in Internet use and general applications, who are willing to attend such a course if available and those who do not wish to attend:
(χ^2 (2, 653) = 753,210, p < ,05). A two-way chi-square statistical analysis using moderator variables such as access to a computer at home, age groups, gender, level of education, having a bachelor's degree, teaching licence and years of teaching experience were used to determine the statistical significance. The number of Science and Mathematics teachers who have participated in an introductory course in Internet use and general applications, who are willing to attend if available and those who do not wish to attend, relative to: (1) whether the number of teachers who have access to a computer at home or not is statistically significantly different: (χ^2 (2, 576) = 8,707, p < ,05); (2) whether the teachers are under or over the age of forty is not statistically significantly different: (χ^2 (2, 644) =,692, p = ,708); (3) whether the teachers are male or female is statistically significant:

(χ^2 (2, 645) = 6,758, p < ,05); (4) whether the teachers are undergraduates or post-graduates is not statistically significant: (χ^2 (2, 638) = 0,460, p = ,795); (5) whether teachers have or do not have a degree in Mathematics or Science or both is statistically significantly different: (χ^2 (2, 645) = 15,520, p < ,05); (6) whether the number of teachers who have a teaching licence or not is not statistically significantly different:(χ^2 (2, 647) = 0,242, p = ,886) and (7) whether the number of teachers who have more or less than ten years' teaching experience is statistically significantly different:(χ^2 (2, 650) = 3,672, p = ,159).

Table 11: Summary of South African Science and Mathematics teachers' participation in an introductory course in Internet use and general applications and their willingness to attend

	Teacher characteristics	Category / Number of respondents				χ^2	p-value	Significant difference
South African Science and Mathematics teachers' participation in an introductory course in Internet use and general applications and their willingness to attend	Experience a lack of ICT-related skills as an obstacle	Teachers' participation in an introductory course in Internet use and general applications and their willingness to attend	No, I do not wish to attend	No, I would like to attend if available	Yes, I have attended			
			20	546	87	753,210	,000	Yes
	Access to a computer at home	Yes	13	230	46	8,707	,013	Yes
		No	6	254	27			
	Age groups	> 40	9	286	47	,692	,708	No
		< 40	11	253	38			
	Gender	Male	4	252	34	6,758	,034	Yes
		Female	16	287	52			
	Level of education	Undergraduates	15	473	72	460	,795	No
		Postgraduates	3	64	11			
	Bachelor's degree	No degree	11	453	62	15,520	,000	Yes
		Degree in Science or Maths or both	9	87	23			
	Teaching licence	Yes	18	497	78	,242	,886	No
		No	2	46	6			
	Years of teaching experience	> 10	10	233	46	3,672	,159	No
		< 10	10	311	40			

Table 12: Summary of South African Science and Mathematics teachers' participation in an advanced course in applications / standard tools and their willingness to attend

	Teacher characteristics	Category / Number of respondents				χ^2	p-value	Significant difference
South African Science and Mathematics teachers' participation in an advanced course in applications / standard tools and their willingness to attend	Experience a lack of ICT-related skills as an obstacle	Teachers' participation in advanced course in applications / standard tools and their willingness to attend	No, I do not wish to attend	No, I would like to attend if available	Yes, I have attended			
			43	585	29	917,954	,000	Yes
	Access to a computer at home	Yes	29	250	12	7,446	,024	Yes
		No	12	264	11			
	Age groups	> 40	16	307	19	6,133	0,047	Yes
		< 40	27	269	10			
	Gender	Male	6	269	18	20,755	,000	Yes
		Female	37	308	11			
	Level of education	Undergraduates	34	505	24	,466	,792	No
		Postgraduates	6	68	4			
	Bachelor's degree	No degree	27	480	22	11,062	,004	Yes
		Degree in Science or Maths or both	16	98	6			
	Teaching licence	Yes	41	527	28	1,856	,395	No
		No	2	51	1			
	Years of teaching experience	> 10	17	254	17	2,893	,235	No
		< 10	26	328	12			

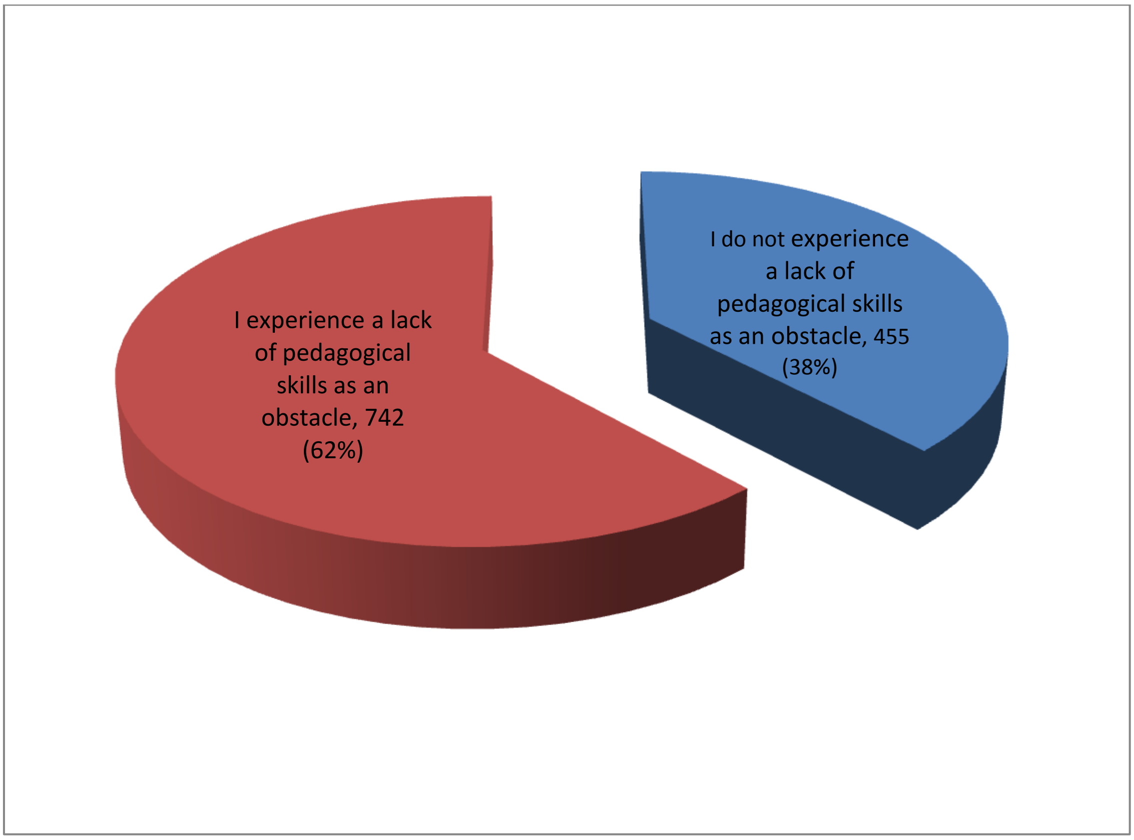
Table 12 shows a summary of South African Science and Mathematics teachers' participation in an advanced course in applications / standard tools and their willingness to attend. A statistically significant difference was found between the number of Science and Mathematics teachers who have participated in an advanced course in applications / standard tools who are willing to attend if such a course is available and those who do not wish to attend: (χ^2 (2, 657) = 917,954, p < ,05). A two-way chi-square statistical analysis using moderator variables such as access to a computer at home, age groups, gender, level of education, having a bachelor's degree, teaching licence and years of teaching experience were used to determine the statistical significance. The number of Science and Mathematics teachers who have participated in an advanced course in applications / standard tools, who are willing to attend if available and those who do not wish to attend, relative to: (1) whether the teachers have access to a computer at home or not is statistically significantly different: (χ^2 (2, 578) = 7,446, p < ,05); (2) whether the teachers are under or over the age of forty is statistically significantly different: (χ^2 (2, 648) = 6,133, p < ,05); (3) whether the teachers are male or female is statistically significant (χ^2 (2, 649) = 20,755, p < ,05); (4) whether teachers are undergraduates or post-graduates is not statistically significant: (χ^2 (2, 641) = 0,466, p = ,792); (5) whether they have a degree or no degree in Mathematics or Science or both is statistically significantly different: (χ^2 (2,649) = 11,062, p < ,05); (6) whether they have a teaching licence or not is not statistically significantly different: (χ^2 (2, 650) = 1,856, p = ,395); and (7) whether the teachers have more or less than ten years' teaching experience is not statistically significant: (χ^2 (2, 654) = 2,893, p = ,235).

4.5 Science and Mathematics teachers who experience a lack of pedagogical skills as an obstacle

Figure 36 shows that 62% (742) of the Science and Mathematics teachers who participated in the SITES 2006 survey reported that they experience a lack of pedagogical skills as an obstacle. Only 38% (455) percent of the teachers do not experience a lack of pedagogical skills as an obstacle (See Addendum A 32). There is a statistically significant difference between the number of Science and

Mathematics teachers who experience a lack of pedagogical skills as an obstacle and those who do not: (χ^2 (1, 1197) = 68,813, p < ,05) (See Addendum A 32.1). Therefore there are 742 Science and Mathematics teachers who experience a lack of pedagogical skills as an obstacle.

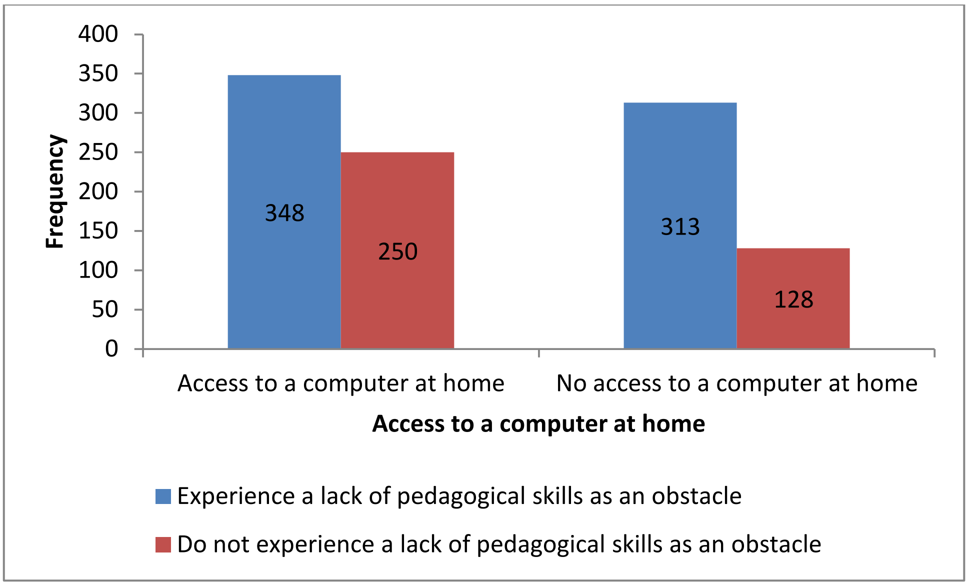
Figure 36: Science and Mathematics teachers who experience a lack of pedagogical skills as an obstacle



4.5.1 Access to a computer at home of Science and Mathematics teachers who experience a lack of pedagogical skills as an obstacle

Figure 37 shows that 348 (53%) of the Science and Mathematics teachers who experience a lack of pedagogical skills as an obstacle have access to computer at home (See Addendum A 33). There is a statistically significant difference between the number of Science and Mathematics teachers who experience a lack of pedagogical skills as an obstacle and those who do not, relative to whether they have access to computer at home or not: (χ^2 (1, 1184) = 7,184, p> ,05) (See Addendum A 33.1).

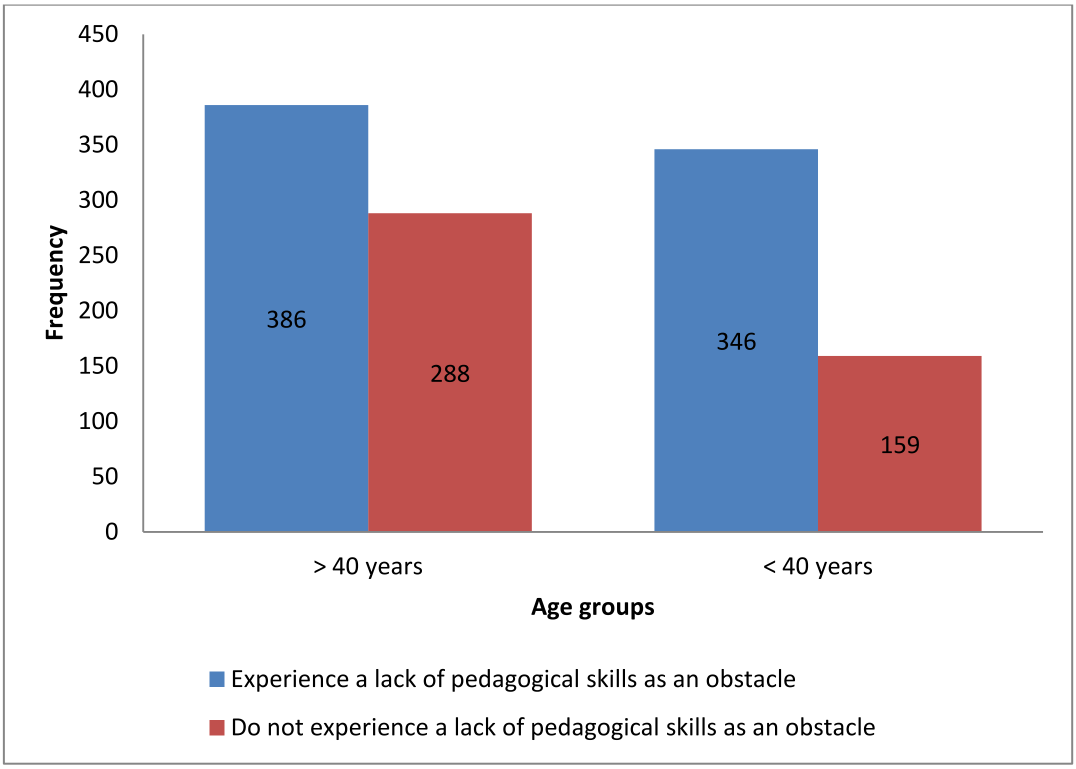
Figure 37: Science and Mathematics teachers who experience a lack of pedagogical skills as an obstacle relative to whether they have access to computer at home or not



4.5.2 Age groups of Science and Mathematics teachers who experience a lack of pedagogical skills as an obstacle

Figure 38 shows that there are 386 (57%) teachers aged under 40 years and 346 (69%) teachers who are over the age of 40 years who experience a lack of pedagogical skills as an obstacle (See Addendum A 34). In comparison there are 288 (43%) teachers under the age of 40 and 159 (31) teachers over the age of 40 who do not experience a lack of pedagogical skills as an obstacle. There is a statistically significant difference between the number of teachers who experience a lack of pedagogical skills as an obstacle and those who do not, relative to their various age groups: (χ^2 (1, 1179) = 15,508, p < ,05) (See Addendum A 34.1). Probability calculations show that teachers who are aged under 40 years (P (A) = ,33) are more likely to experience a lack of pedagogical skills as an obstacle than teachers who are aged over 40 years (P (A) = ,29) (See Addendum A 34.2).

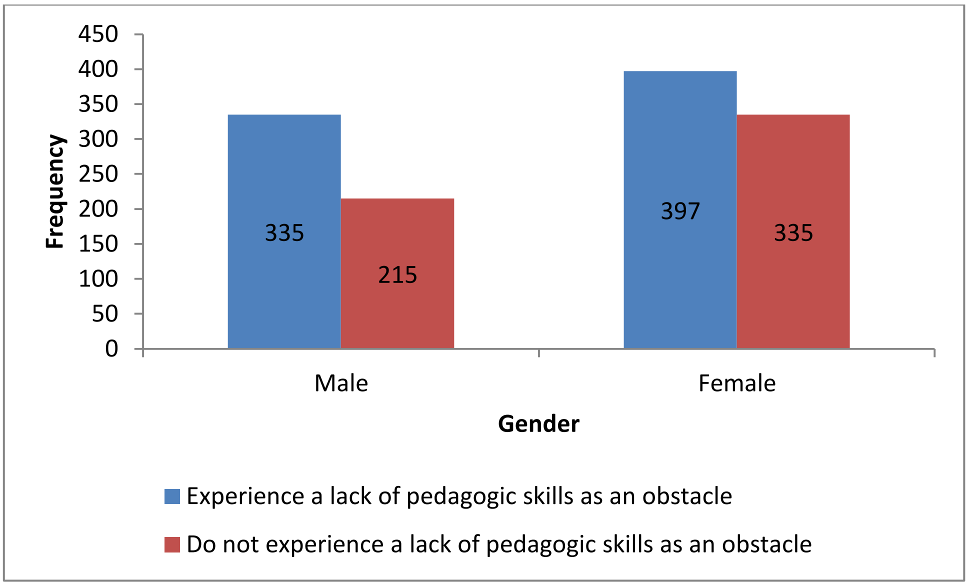
Figure 38: Age groups of Science and Mathematics teachers who experience a lack of pedagogical skills as an obstacle



4.5.3 Gender distribution of Science and Mathematics teachers who experience a lack of pedagogical skills as an obstacle

In terms of gender, as shown in Figure 39, it has been established that more females (54%) (397) experience a lack of pedagogical skills as an obstacle as opposed to males (46%) (335) (See Addendum A 35). It should be noted, however, that these results do not mean that male teachers are more inclined to use ICT-related technologies than female teachers when teaching Science and Mathematics. This is because the percentage also reflects that more (54%) female teachers participated in the survey than male teachers (46%). This suggests that gender is not an important indicator in experiencing or not experiencing a lack of pedagogical skills as an obstacle. Gender wise, there are 397 females and 335 males who experience a lack of pedagogical skills as an obstacle.

Figure 39: Gender distribution of Science and Mathematics teachers who experience a lack of pedagogical skills as an obstacle

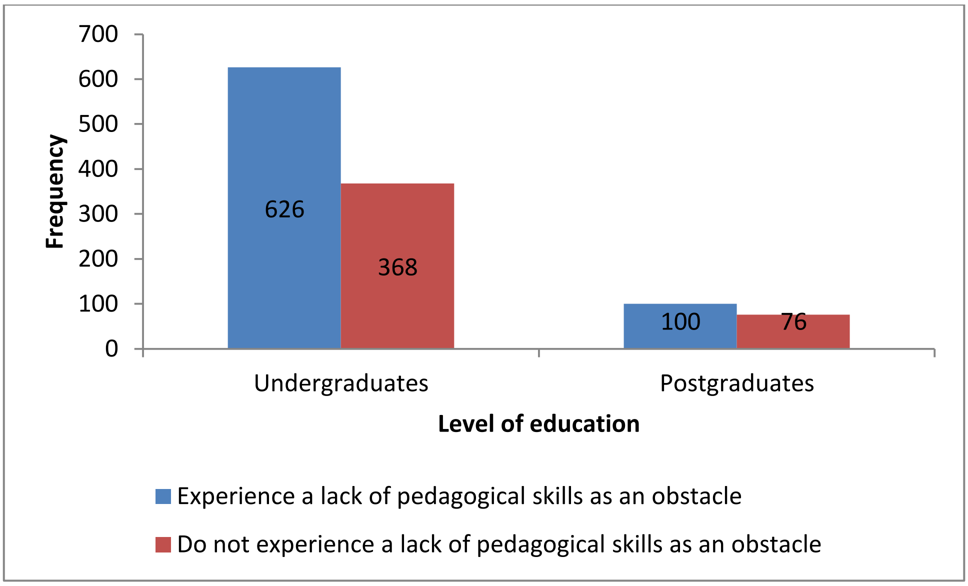


The two-way chi-square statistic results have revealed that the difference between the number of male and female Science and Mathematics teachers who experience a lack of pedagogical skills as an obstacle and those who do not is not statistically significant: (χ^2 (1, 1182) = ,454, p = ,501) (See Addendum A 35.1).

4.5.4 Level of education of Science and Mathematics teachers who experience a lack of pedagogical skills as an obstacle

Figure 40 shows that there are 626 (86%) undergraduate and 100 (14%) post-graduate Science and Mathematics teachers who experience a lack of pedagogical skills as an obstacle (See Addendum A 36). The two-way chi-square statistic results reveal that the difference between the number of undergraduate and postgraduate South African Science and Mathematics teachers who experience a lack of pedagogical skills as an obstacle and those who do not is not statistically significant: (χ^2 (1, 1170) = 2,409, p = ,121) (See addendum A 36.1). The probability calculations show that undergraduate Science and Mathematics teachers are more likely (P (A) = ,54) to lack the required pedagogical skills as opposed to postgraduate Science and Mathematics teachers (P (A) = ,09) (See addendum A 36.2).

Figure 40: Level of education of Science and Mathematics teachers who experience a lack of pedagogical skills as an obstacle

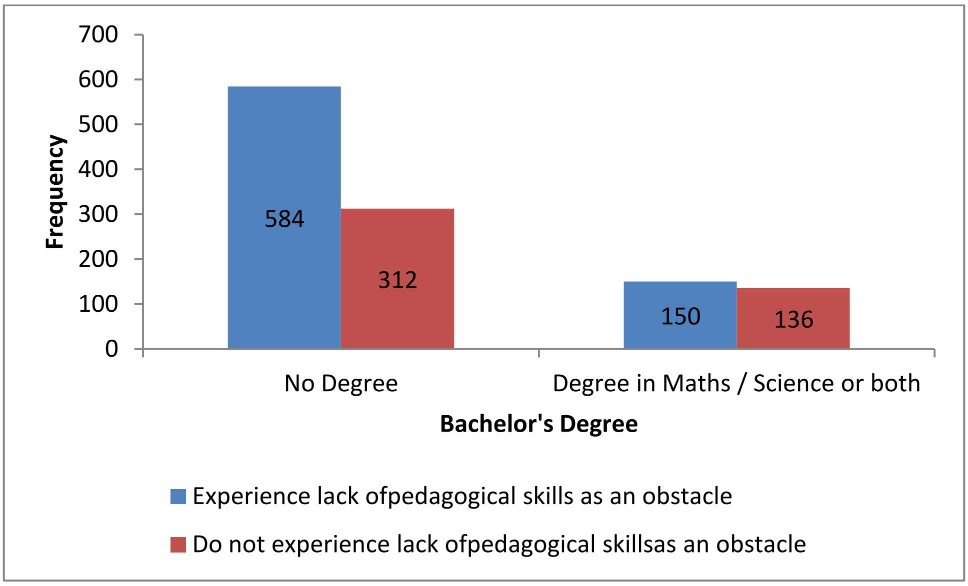


4.5.5 Bachelor's degree obtained by Science and Mathematics teachers who experience a lack of pedagogical skills as an obstacle

The problem of experiencing a lack of pedagogical skills as an obstacle among South African Science and Mathematics teachers is worse for those teachers who do not have a degree in either Mathematics or Science (See Addendum A 37). Figure 41 shows that 65% (584) of teachers who do not have a degree in Science or Mathematics experience a lack of pedagogical skills as an obstacle. On the other hand, only 35% (150) of teachers who have a degree in Science or Mathematics or both experience a lack of pedagogical skills as an obstacle. The two-way chi-square statistic results have revealed that there is a statistical significant difference between the number of South African Science and Mathematics teachers who experience a lack of pedagogical skills as an obstacle and those who do not, relative to whether they have a Degree in Mathematics / Science or not: (χ^2 (1, 1182) = 14,929, p < ,05) (See Addendum A 37.1). Probability calculations also confirm that Science and Mathematics teachers who do not have a degree in either Science or Mathematics are more likely (P (A) = ,49) to experience a lack of pedagogical skills as an obstacle as opposed to those who have a degree in Science or Mathematics or both:

(P (A) = ,13) (See Addendum A 37.2).

Figure 41: Bachelor's degree obtained by Science and Mathematics teachers who experience a lack of pedagogical skills as an obstacle

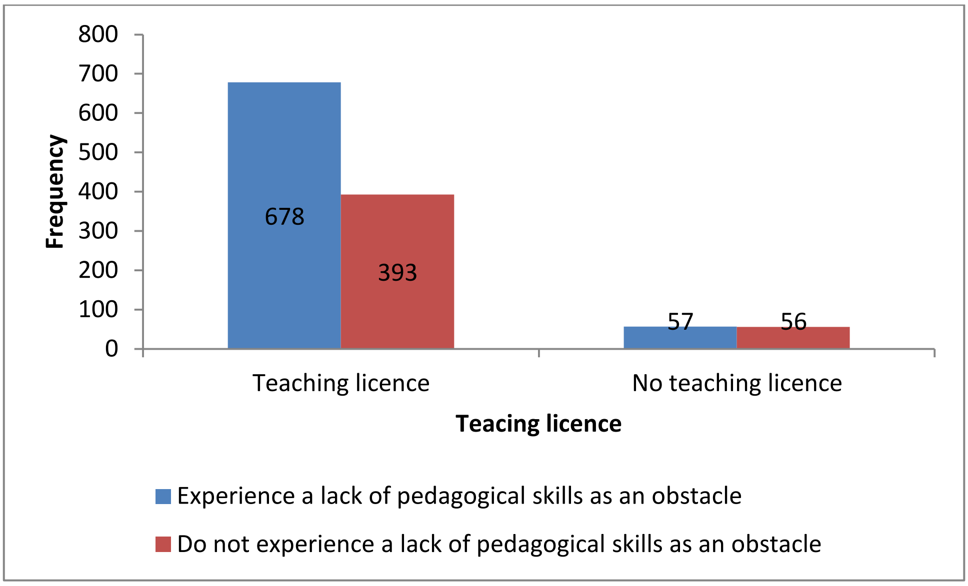


4.5.6 Teaching licence or certificate obtained by Science and Mathematics teachers who experience a lack of pedagogical skills as an obstacle

Figure 42 shows that having a teaching licence does not aid Science and Mathematics teachers experiencing a lack of pedagogical skills as an obstacle. This is because 92% (678) of the South African Science and Mathematics teachers who have a teaching licence experience a lack of pedagogical skills as an obstacle (See Addendum A 38).

There is a statistical significant difference between the number of South African Science and Mathematics teachers who experience a lack of pedagogical skills as an obstacle, relative to whether they have a teaching licence / certificate or not: (χ^2 (1, 1184) = 7,184, p < ,05) (See Addendum A 38.1). Moreover, probability calculations reveal that teachers with a teaching licence are more likely (P (A) = ,57) to experience a lack of pedagogical skills as an obstacle as opposed to the teachers with no teaching licence (P (A) = ,05) (See Addendum A 38.2).

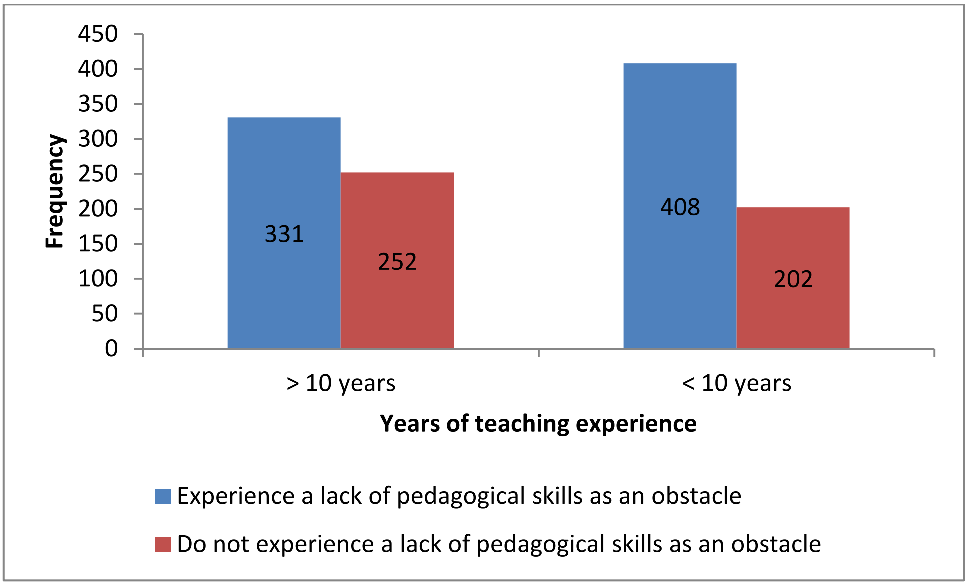
Figure 42: Science and Mathematics teachers who experience a lack of pedagogical skills as an obstacle relative to whether they have a teaching licence / certificate or not



4.5.7 Years of teaching experience of Science and Mathematics teachers who experience a lack of pedagogical skills as an obstacle

Figure 43 shows that 331 (57%) teachers who have less than ten years' teaching experience and 408 (67%) teachers who have taught for more than ten years experience a lack of pedagogical skills as an obstacle. However, 252 (43%) teachers with less than ten years' teaching experience and 202 (33%) teachers who have more than ten years teaching' experience do not experience a lack of pedagogical skills as an obstacle (See Addendum A 39). The two-way statistical results indicate that there is a statistically significant difference between the number of teachers who experience a lack of pedagogical skills as an obstacle and those who do not, relative to their years of teaching experience: (χ^2 (1, 1193) = 12,925, $p <$,05) (See Addendum A 39.1). Probability calculations show that teachers with more than ten years' teaching experience are more likely (P (A) = ,34) to experience a lack of pedagogical skills as an obstacle as opposed to teachers with less than ten years' teaching experience (P (A) = ,28) (See Addendum A 39.2).

Figure 43: Years of teaching experience of Science and Mathematics teachers who experience a lack of pedagogical skills as an obstacle



4.5.8 Summary

The summary shown in Table 13 indicates that there is a statistically significant difference between the number of Science and Mathematics teachers who experience a lack of pedagogical skills as an obstacle in their teaching and those who do not experience it as an obstacle: (χ^2 (1, 1197) = 68,813, p < ,05).

To determine the statistical significant difference between the number of teachers who experience a lack of pedagogical skills as an obstacle and those who do not, other moderator variables such as access to a computer at home, age groups, gender, level of education, having a bachelor's degree, teaching licence and years of teaching experience were used. The two-way chi-square statistical results reveal that:(1) the number of Science and Mathematics teachers who have access to a computer at home and those who do not is not statistically significantly different: (χ^2 (1, 1184) = 7,184, p> ,05); (2) the number of teachers who are under 40 years of age and those who are over 40 years old is statistically significantly different:

(χ^2 (1, 1179) = 15,508, p < ,05); (3) the number of male and female Science and Mathematics teachers is not statistically significantly different: (χ^2 (1, 1182) = ,454, p = ,501); (4) the number of undergraduate and postgraduate Science and Mathematics teachers is not statistically significantly different: (χ^2 (1, 1170) = 2,409, p = ,121); (5) the difference between the number of teachers who have no degree and those who have one in Mathematics, Science or both is statistically significant: (χ^2 (1, 1182) = 14,929, p < ,05); (6) the difference between the number of teachers who have a teaching licence and those who do not is statistically significantly different: (χ^2 (1, 1184) = 7,184, p < ,05); and (7) there is a statistically significant difference between the number of teachers with less than ten years' teaching experience and those with more than ten years' teaching experience: (χ^2 (1, 1193) = 12,925, p < ,05).

Table 13: Summary of South African Science and Mathematics teachers experiencing obstacles regarding to pedagogical skills related to integrating ICT into teaching and learning

	Teacher characteristics	Category / Number of respondents			χ^2	p-value	Significant difference
South African Science and Mathematics teachers obstacles related to pedagogical skills related to integrating ICT into instruction and learning	Experience a lack of pedagogical skills related to integrating ICT into teaching and learning as an obstacle		Yes	No	68,813	,000	Yes
			742	455			
	Access to a computer at home	Yes	348	250	7,184	,007	Yes
		No	313	128			
	Age groups	> 40	386	288	15,508	,000	Yes
		< 40	346	159			
	Gender	Male	335	215	,454	,501	No
		Female	397	235			
	Level of education	Undergraduates	626	368	2,409	,121	No
		Postgraduates	100	76			
	Bachelor's degree	No degree	584	312	14,929	,000	Yes
		Degree in Science / Maths or both	150	136			
	Teaching licence	Yes	678	93	7,184	,007	Yes
		No	57	56			
	Years of teaching experience	> 10	331	252	12,925	,000	Yes
		< 10	408	202			

4.6 Science and Mathematics teachers' participation in a course in pedagogical issues related to integrating ICT into instruction and learning and their willingness to attend

Table 14 shows that 4.5% (33) of the Science and Mathematics teachers who experience a lack of pedagogical skills as an obstacle have participated in a course in pedagogical issues related to integrating ICT in instruction and learning. The future looks bright, though, for improving South African Science and Mathematics teachers' pedagogical skills related to integrating ICT into instruction and learning. This is because 93% (681) of those teachers who experience a lack of pedagogical skills as an obstacle are willing to attend a course in pedagogical issues if available (See Addendum A 40).

Table 14: Science and Mathematics teachers' participation in a course in pedagogical issues related to integrating ICT into instruction and learning and their willingness to attend

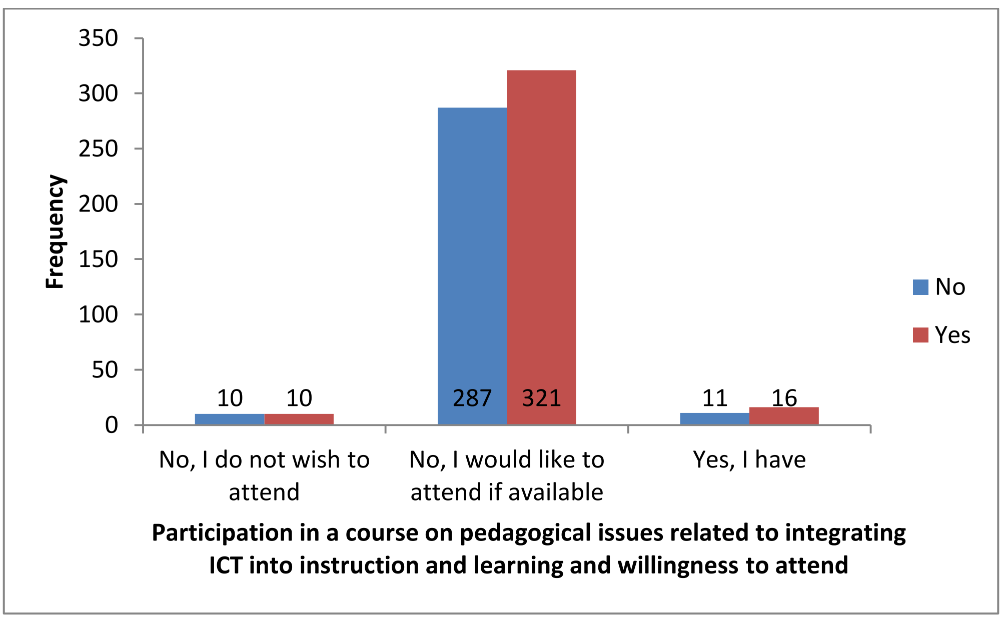
	Frequency	Percentage (%)
No, I do not wish to attend	22	3.0
No, I would like to attend if available	681	92.5
Yes, I have attended	33	4.5
Total	**736**	**100**
Chi-square		1160,742[a]
df		2
Asymp. Sig.		,000

There is a statistically significant difference between the number of Science and Mathematics teachers who have participated in a course in pedagogical issues related to integrating ICT in instruction and learning who are willing to attend if such a course is available and those who do not wish to attend:
(χ^2 (2, 736) = 1160,742, $p < ,05$) (See Addendum A 40.1).

4.6.1 Access to a computer at home of South African Science and Mathematics teachers who participated in a course in pedagogical issues related to integrating ICT into instruction and learning and their willingness to attend

Figure 44 indicates that there are 287 (93%) teachers who do not have access to a computer at home and 321 (93%) teachers who do and who have not participated in a course in pedagogical issues related to integrating ICT into instruction and learning, who are willing to attend. Only 10 (3%) teachers who have no access to a computer at home and 10 (3%) teachers who do have access to a computer at home are not willing to attend a course in pedagogical issues related to integrating ICT into instruction and learning, despite the fact that they experience a lack of ICT-related skills as an obstacle. There are 11 (4%) teachers who have no access to a computer at home and 16 (5%) teachers who have access to a computer at home who have participated in a course in pedagogical issues related to integrating ICT into instruction and learning (See Addendum A 41).

Figure 44: Access to a computer at home of South African Science and Mathematics teachers who participated in a course in pedagogical issues related to integrating ICT into instruction and learning and their willingness to attend



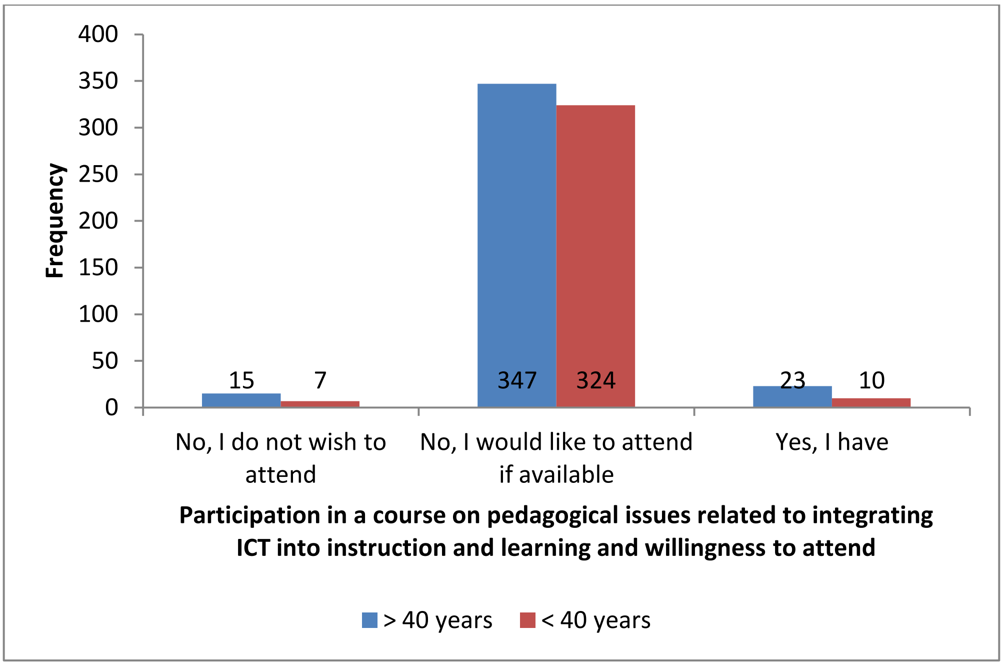
The two-way chi-square test results reveal that the difference between the number of teachers who are not willing to attend, who are willing to attend and those who have already attended a course in pedagogical issues related to integrating ICT into instruction and learning, relative to whether they have access to a computer at home or not, is not statistically significant: (χ^2 (2, 655) = 0,507, p = ,776) (See Addendum A 41.1).

4.6.2 Age groups of South African Science and Mathematics teachers who participated in a course in pedagogical issues related to integrating ICT into instruction and learning and their willingness to attend

Figure 45 shows that 347 (90%) teachers who are under forty years of age and 324 (95%) teachers who are over forty years of age who have not participated in a course in pedagogical issues related to integrating ICT into instruction and learning are willing to attend. Only 15 (4%) teachers who are under the age of 40 and 7 (2%) teachers who are over the age of 40 years are not willing to attend. There are 23 (6%) teachers who are under the age of 40 years and 10 (3%) teachers who are over the age of 40 years who have participated in a course in pedagogical issues related to integrating ICT into instruction and learning (See Addendum A 42).

The two-way chi-square test results reveal that there is a statistically significant difference between the number of teachers who are not willing to attend, who are willing to attend and those who have already attended a course in pedagogical issues related to integrating ICT into instruction and learning relative to whether they are under or over 40 years of age: (χ^2 (2, 726) = 6,175, p < ,05) (See Addendum A 42.1).

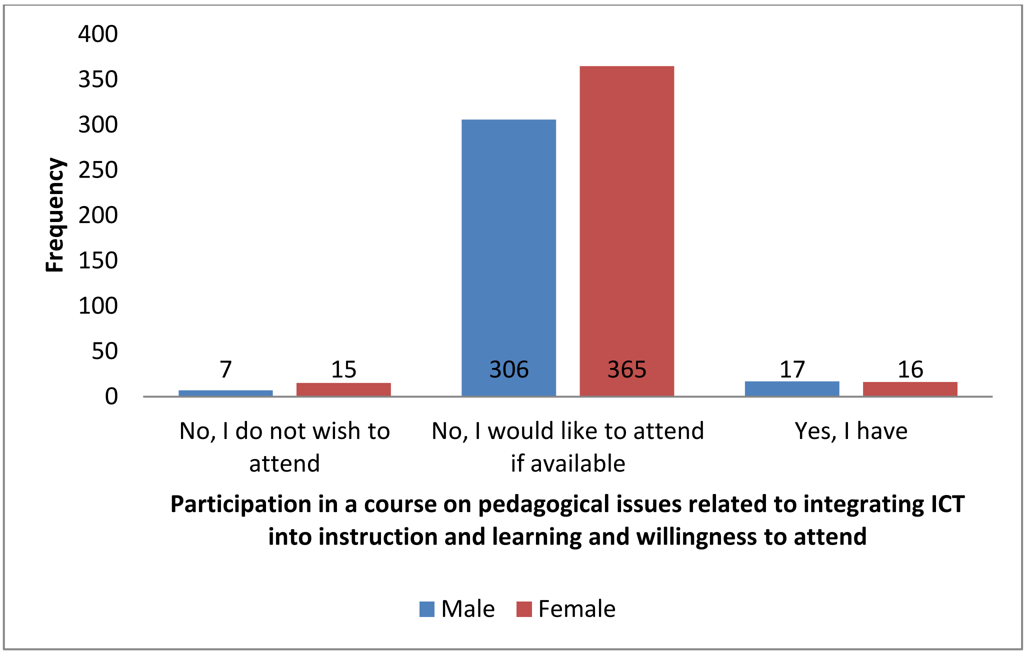
Figure 45: Age groups of South African Science and Mathematics teachers who participated in a course in pedagogical issues related to integrating ICT into instruction and learning and their willingness to attend



4.6.3 Gender distribution of South African Science and Mathematics teachers who participated in a course in pedagogical issues related to integrating ICT into instruction and learning and their willingness to attend

Figure 46 shows that there are 365 (92%) female teachers and 306 (93%) male teachers who have not participated in a course in pedagogical issues related to integrating ICT into instruction and learning who are willing to attend a course in pedagogical issues. There are 15 (4%) female and 7 (2%) male teachers who are not willing to attend. There are only 16 (4%) female and 17 (5%) male teachers who have attended a course in pedagogical issues related to integrating ICT into instruction and learning (See Addendum A 43).

Figure 46: Gender distribution of South African Science and Mathematics teachers who participated in a course in pedagogical issues related to integrating ICT into instruction and learning and their willingness to attend

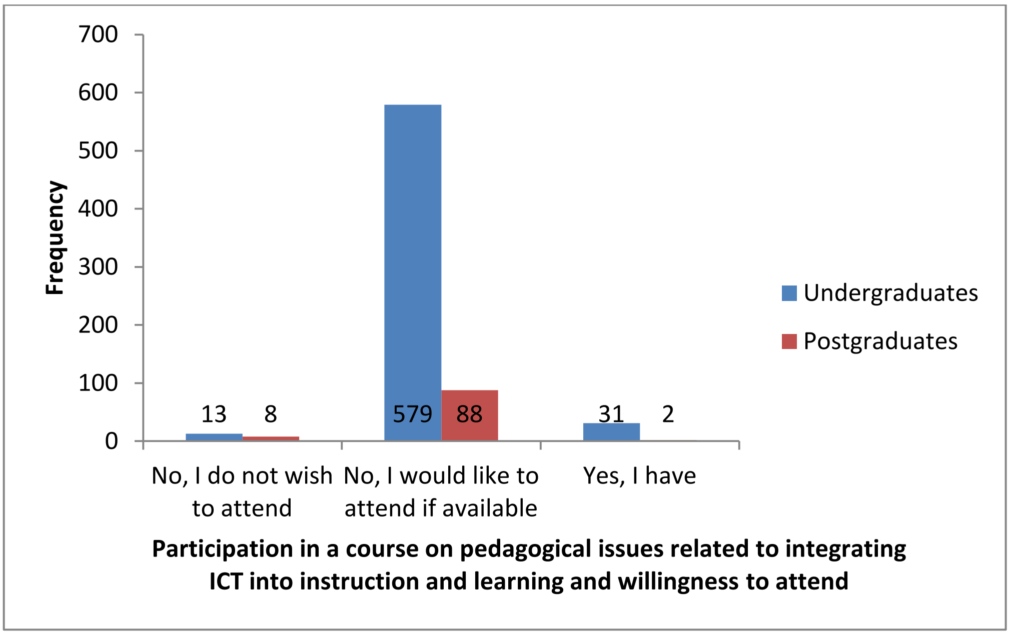


The difference between the number of teachers who are not willing to attend, who are willing to attend and those who have already attended a course in pedagogical issues related to integrating ICT into instruction and learning, relative to whether they are male or female, is not statistically significant: (χ^2 (2, 726) = 2,145, p = ,342) (See Addendum A 43.1).

4.6.4 Level of education of South African Science and Mathematics teachers who participated in a course in pedagogical issues related to integrating ICT into instruction and learning and their willingness to attend

Figure 47 shows that there are 579 (93%) undergraduates and 88 (90%) postgraduates who have not participated in a course in pedagogical issues related to integrating ICT into instruction and learning who are willing to attend a course in pedagogical issues. There are 13 (2%) undergraduates and 8 (8%) postgraduates who are not willing to attend an introductory course in pedagogical issues related to integrating ICT into instruction and learning despite the fact that they experience the lack of ICT-related skills as an obstacle. There are 31 (5%) undergraduates and 2 (2%) post graduates who have participated in a course in pedagogical issues related to integrating ICT into instruction and learning (See Addendum A 44).

Figure 47: Level of education of South African Science and Mathematics teachers who participated in a course in pedagogical issues related to integrating ICT into instruction and learning and their willingness to attend

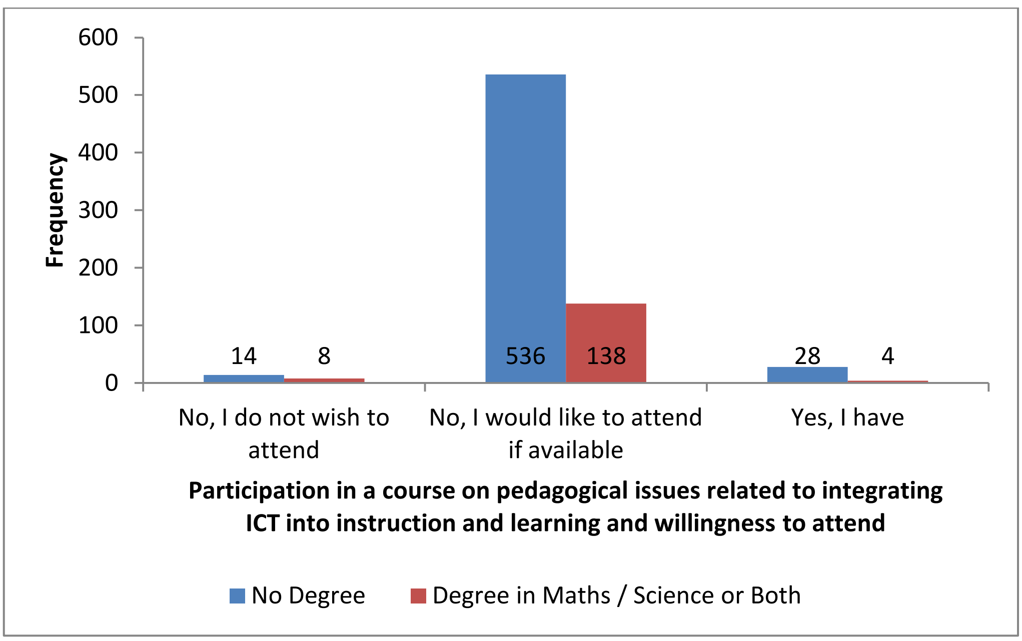


The difference between the number of teachers who are not willing to attend, who are willing to attend and those who have already attended a course in pedagogical issues related to integrating ICT into instruction and learning, relative to whether they are undergraduates or postgraduates is not statistically significant: (χ^2 (2, 721) = 12,419, p < ,05) (See Addendum A 44.1).

4.6.5 Bachelor's degree obtained by South African Science and Mathematics teachers who participated in a course in pedagogical issues related to integrating ICT into instruction and learning and their willingness to attend

Figure 48 shows that there are 536 (93%) teachers who do not have a degree and 138 (92%) teachers who have a degree in Mathematics or Science or both who have not participated in a course in pedagogical issues related to integrating ICT into instruction and learning who are willing to attend. On the other hand, there are 14 (2%) teachers with no degree and 8 (5%) teachers with a degree in Science or Mathematics or both who are not willing to attend such a course, despite the fact that they experience a lack of ICT-related skills as an obstacle. There are only 28 (5%) teachers with no degree and 4 (3%) teachers with a degree in Science or Mathematics or both who have participated in a course in pedagogical issues related to integrating ICT into instruction and learning (See Addendum A 45).

Figure 48: Bachelor's degree obtained by South African Science and Mathematics teachers who participated in a course in pedagogical issues related to integrating ICT into instruction and learning and their willingness to attend

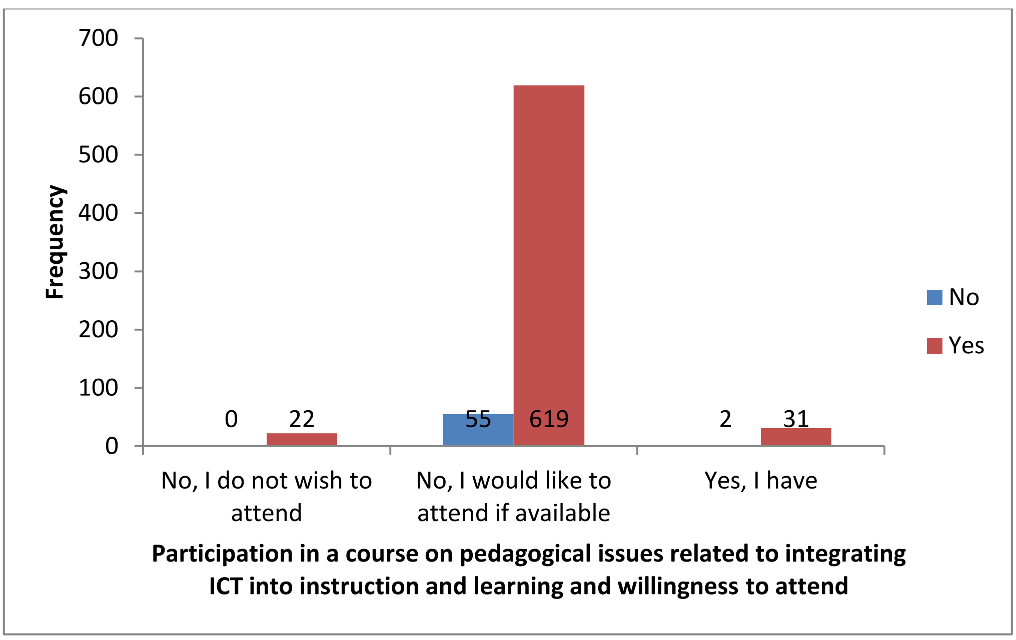


The difference between the number of teachers who are not willing to attend, who are willing to attend and those who have already attended a course in pedagogical issues related to integrating ICT into instruction and learning, relative to whether they have or do not have a degree in Mathematics or Science or both, is not statistically significant: (χ^2 (2, 728) = 4,632, p = ,099) (See Addendum A 45.1).

4.6.6 Teaching licence or certificate obtained by South African Science and Mathematics teachers who participated in a course in pedagogical issues related to integrating ICT into instruction and learning and their willingness to attend

Figure 49 shows that there are 55 (96%) teachers who do not have a teaching licence and 619 (92%) teachers who have a teaching licence who have not participated in a course in pedagogical issues related to integrating ICT into instruction and learning who are willing to attend such a course.

Figure 49: Teaching licence or certificate obtained by South African Science and Mathematics teachers who participated in a course in pedagogical issues related to integrating ICT into instruction and learning and their willingness to attend



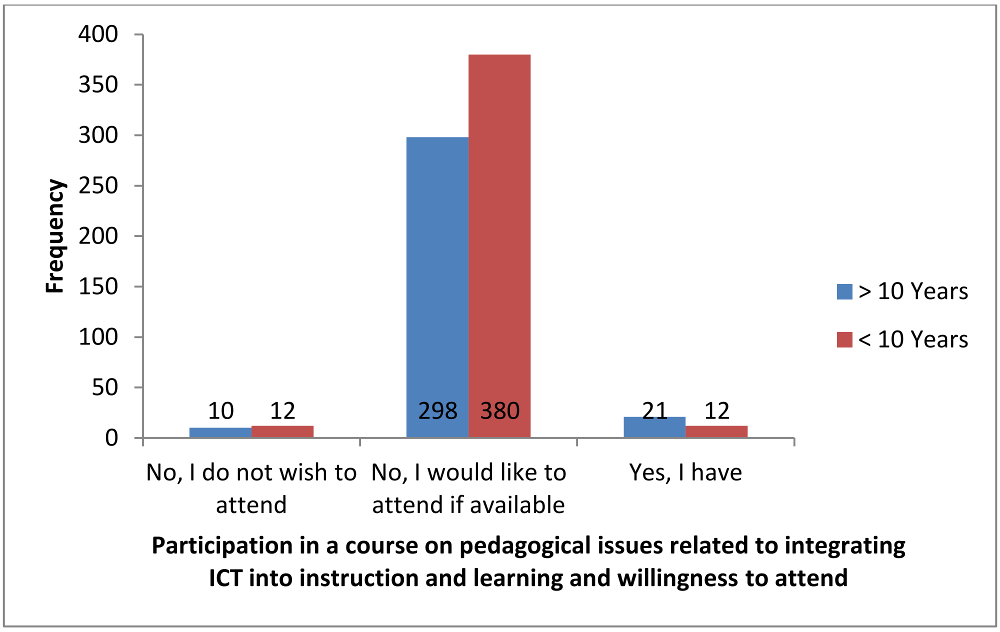
There are no teachers without a teaching licence and there are 22 (3%) teachers with a teaching licence who are not willing to attend, despite the fact that they experience a lack of ICT-related skills as an obstacle. There are only 2 (4%) teachers with no teaching licence and 31 (5%) teachers with a teaching licence who have participated in a course in pedagogical issues related to integrating ICT into instruction and learning (See Addendum A 46). The difference between the number of teachers who are not willing to attend, who are willing to attend and those who have already attended a course in pedagogical issues related to integrating ICT into instruction and learning, relative to whether they have teaching a licence or not, is statistically significantly different: (χ^2 (2, 729) = 2,117, p < ,05) (See Addendum A 46.1).

4.6.7 Years of teaching experience of South African Science and Mathematics teachers who participated in a course in pedagogical issues related to integrating ICT into instruction and learning and their willingness to attend

Figure 50 shows that there are 298 (91%) teachers who have less than ten years' teaching experience and 380 (94%) teachers who have more than ten years' teaching experience who have not participated in a course in pedagogical issues related to integrating ICT into instruction and learning who are willing to attend such a course.

There are 10 (3%) teachers who have less than ten years' teaching experience and 12 (3%) teachers who have more than ten years' teaching experience who are not willing to attend, despite the fact that they experience a lack of ICT-related skills as an obstacle. There are only 21 (6%) teachers who have less than ten years' teaching experience and 12 (3%) teachers who have more than ten years' teaching experience who have participated in a course in pedagogical issues related to integrating ICT into instruction and learning (See Addendum A 47). The difference between the number of teachers who are not willing to attend, who are willing to attend and those who have already attended a course in pedagogical issues related to integrating ICT into instruction and learning, relative to whether they teachers who have less or more than ten years' teaching experience, is not statistically significant: (χ^2 (2, 733) = 4,931, p = ,085) (See Addendum A 47.1).

Figure 50: Years of teaching experience of South African Science and Mathematics teachers who participated in a course in pedagogical issues related to integrating ICT into instruction and learning and their willingness to attend



4.6.8 Summary

Table 15 shows a summary of South African Science and Mathematics teachers' participation in a course in pedagogical issues related to integrating ICT into instruction and learning and their willingness to attend such a course. A statistically significant difference has been found between the number of Science and Mathematics teachers who have participated in a course in pedagogical issues related to integrating ICT into instruction and learning who are willing to attend such a course if available and those who do not wish to attend it:
(χ^2 (2, 736) = 917,954, p < ,05).

A two-way chi-square statistical analysis using moderator variables such as access to a computer at home, age groups, gender, level of education, having a bachelor's degree, teaching licence and years of teaching experience were used to determine the statistical significance. The number of Science and Mathematics teachers who have participated in a course in pedagogical issues related to integrating ICT into instruction and learning who are willing to attend such a course if available and those who do not wish to attend, relative to (1) whether the number of teachers that have access to a computer at home or not is statistically significantly different: (χ^2 (2, 655) = 0,507, p = ,776); (2) whether the number of teachers that are under or over the age of forty is statistically significantly different: (χ^2 (2, 726) = 6,175, p < ,05); (3) whether the number of teachers that are male or female is not statistically significant: (χ^2 (2, 726) = 2,145, p = ,342); (4) whether the number of teachers that are undergraduates or postgraduates is not statistically significant: (χ^2 (2, 721) = 12,419, p < ,05); (5) whether the number of teachers having or not having a degree in Mathematics or Science or both is not statistically significantly significant: (χ^2 (2, 728) = 4,632, p = ,099); (6) whether the number of teachers that have a teaching licence or not is statistically significantly different: (χ^2 (2, 729) = 2,117, p < ,05); and (7) whether the number of teachers who have less or more than ten years' teaching experience is not statistically significant: (χ^2 (2, 733) = 4,931, p = ,085).

Table 15: Summary of South African Science and Mathematics teachers' participation in a course in pedagogical issues related to integrating ICT into instruction and learning and their willingness to attend

	Teacher characteristics	Category / Number of respondents				χ^2	p- value	Significant difference
South African Science and Mathematics teachers' participation in a course in pedagogical issues related to integrating ICT into teaching and learning and their willingness to attend	Experience a lack of pedagogical skills related to integrating ICT into instruction and learning as an obstacle	Teachers' participation in a course in pedagogical issues and their willingness to attend	No I do not wish to attend	No, I would like to attend if available	Yes, I have attended			
		Yes	22	681	33	1160,742	,000	Yes
	Access to a computer at home	Yes	10	321	16	,507	,776	No
		No	10	287	11			
	Age groups	> 40	15	347	23	6,175	,046	Yes
		< 40	7	324	10			
	Gender	Male	7	306	17	2,145	,342	No
		Female	15	365	16			
	Level of education	Undergraduates	13	579	31	12,419	,002	Yes
		Postgraduates	8	88	2			
	Bachelor's degree	No degree	14	536	28	4,632	,099	No
		Degree in Science or Maths or both	8	138	4			
	Teaching licence	Yes	22	619	31	2,117	,347	No
		No	0	55	2			
	Years of teaching experience	> 10	10	298	21	4,931	,085	No
		< 10	12	380	12			

Chapter 5 – Summary, discussions, implications, conclusions and recommendations

5.1 Introduction

This chapter provides a brief summary of the study and discusses the findings. The results are discussed in relation to findings of prior research and are placed within the context of a larger body of literature on the topic. The theoretical and practical implications and limitations of the study are also discussed. The chapter ends by discussing the conclusions that have resulted from the study, and by making recommendations for policy and practice, and for future research.

5.2 Summary

The overriding purpose of this study is to explore the training needs of South African Science and Mathematics teachers relating to ICT and their willingness to be trained. This was done through a secondary analysis of the SITES 2006 dataset using an integrated qualitative-quantitative approach. To achieve this goal a literature review on (1) secondary data; (2) professional development; (3) ICT-related skills; (4) ICT-related pedagogical skills and (5) SITES 2006 previous studies was undertaken. The literature review did not identify only themes that emerged in previous studies and gaps that need to be filled, but also helped to formulate the theoretical framework on which this study pivots.

The data for the secondary data analysis was collected from the IEA (International Association for the Evaluation of Educational Achievement) data repository that consists of the dataset for the 22 countries that participated in the SITES 2006 study. From this database information relating only to South African Science and Mathematics teachers was queried, and 622 Science teachers' records and 666 Mathematics teachers' records were utilised. To achieve the research objectives outlined in the first chapter of the dissertation, part of question 23 and part of question 24 found in the teacher questionnaire used in the primary study were used (See Appendix B).

The ICT needs of South African Science and Mathematics teachers have been determined by investigating the number of teachers who experience a lack of ICT-related skills as an obstacle, and the number of teachers who experience a lack of pedagogical skills as an obstacle. Furthermore, the teachers who experience a lack of ICT-related skills as an obstacle and those who experience a lack of pedagogical skills as an obstacle were asked whether they are willing to attend professional development courses if available.

Table 16: Summary of the findings

ICT development needs	Yes	No	Willingness to attend	I have attended	Willing to attend	Not willing to attend
Experience a lack of ICT-related skills as an obstacle	664 (55%)	537 (45%)	An introductory course in Internet use and general applications if available	87 (13%)	546 (84%)	20 (3%)
			Advanced course in applications / standard tools if available	29 (4%)	585 (88%)	43 (7%)
Experience a lack of pedagogical skills as an obstacle	742 (62%)	455 (38%)	A course in pedagogical issues if available	33 (5%)	681 (93%)	22 (3%)

The results shown in Table 16 indicate that 55% (664) of Science and Mathematics teachers experience a lack of ICT-related skills as an obstacle in their teaching. Only 45% (537) of the teachers do not experience a lack of ICT-related skills as an obstacle. A total of 84% (546) of Science and Mathematics teachers who experience a lack of ICT-related skills are willing to attend an introductory course in Internet use and general applications if available. It has been found that 88% (585) of Science and Mathematics teachers who experience a lack of ICT-related skills are willing to attend an advanced course in applications / standard tools if available. However, 62% (742) of Science and Mathematics teachers who participated in the SITES 2006 survey reported that they experience a lack of pedagogical skills as an obstacle. On a positive note 93% (681) of those teachers who experience a lack of pedagogical skills as an obstacle are willing to attend a course in pedagogical issues if available.

The high percentage (55%) of Science and Mathematics teachers who experience a lack of ICT-related skills as an obstacle means that these teachers have a need for ICT development. This is also shown by the high percentage (62%) of Science and Mathematics teachers who experience a lack of pedagogical skills related to integrating ICT into instruction and learning as an obstacle.

5.3 Discussion

In this section the research findings are discussed per research question. The reasons for the findings presented are also discussed, and the findings are discussed in the light of previous studies.

5.3.1 Research question 1(a)

What proportion of South African Science and Mathematics teachers require a professional development course in Internet use, general applications and advanced courses for applications?

The results indicate that there is a great need among South African Science and Mathematics teachers to attend professional development courses since there are many teachers who experience a lack of ICT-related skills as an obstacle (55%). It is imperative for teachers to attend professional development activities so that they can be equipped with 21st Century skills and become more proficient in their practice and also equip their learners with 21st Century skills.

As has been proposed in the theoretical framework a lack of ICT-related skills could be the result of a number of obstacles including a lack of expertise, ICT infrastructure, digital resources and time. However, this study concentrated on expertise that relates to whether or not teachers possess the required ICT-related skills only. The high number of teachers who experience a lack of ICT-related skills as an obstacle could be attributed to a number of factors. Firstly, individual teachers do not realise the need for developing 21st Century skills, in particular Information, Media and Technology skills. Once teachers realise the need to develop 21st Century skills they will be intrinsically motivated to attend professional development activities; as a result the number of teachers who experience a lack of ICT-related skills as an obstacle will significantly decrease. Secondly, teaching in South Africa does not compel teachers to develop ICT competency. Teachers still have the liberty to avoid activities that require the use of ICT. Teachers should be compelled to integrate ICT-related activities in their day to day teaching. Teachers should also be required to keep some of their administrative records online on national and regional databases for educational officers to access these records at any time. In this way teachers can be encouraged to develop their ICT skills.

5.3.2 Research question 1(b)

> What proportion of South African Science and Mathematics teachers who require a professional development course in Internet use, general applications and advanced courses for applications are willing to be trained?

The results indicate that the teachers who experience a lack of ICT-related skills are willing to attend an introductory course in Internet use and general applications (84%) if available, and an advanced course in applications / standard tools (88%) if available. The Science and Mathematics teachers' willingness to attend professional development activities is a positive sign since they are intrinsically motivated to attend professional development activities. There is therefore a great need for schools to afford teachers the opportunity to attend professional development activities. The Government should also ensure that teachers continually attend professional development activities so that they become ICT competent and more proficient in their practice. Willingness to attend professional development activities is an individual decision. However, the Government and schools can play an important role in positively encouraging teachers to attend professional development activities.

5.3.3 Research question 2(a)

What proportion of South African Science and Mathematics teachers require a professional development course in pedagogical issues related to integrating ICT into instruction and learning?

The research results indicate that South African Science and Mathematics teachers who experience a lack of pedagogical skills as an obstacle is relatively high (62%), and this implies that there is a great need for teachers to attend professional development courses in pedagogical issues related to integrating ICT into instruction and learning.

Many explanations can be listed for the high number of teachers who experience a lack of pedagogical skills as an obstacle. Firstly, if teachers do not have the required ICT-related skills they cannot integrate ICT into instruction and learning. Research shows that there is a positive correlation between teacher competence in using ICT and the integration of ICT in teaching (r = 0,71 for Science and r = 0,58 for Mathematics) (Ainley, Eveleigh, Freeman & O'Malley, 2010). Therefore the best way of ensuring that teachers successfully integrate ICT in instruction and learning is by equipping them with ICT skills first. Secondly, besides having the required ICT-related skills, teachers need to undergo subject-specific training on how to integrate ICT in instruction and learning. This is because having the required ICT-related skills is one thing, and integrating ICT in instruction and learning is another.

5.3.4 Research question 2(b)

What proportion of those South African Science and Mathematics teachers who require a professional development course in pedagogical issues related to integrating ICT into instruction and learning are willing to be trained?

The results indicate that 93% of Science and Mathematics teachers who experience a lack of pedagogical skills are willing to attend a professional development course in pedagogical issues related to integrating ICT into instruction and learning. If these teachers are willing to improve their practice through attending professional development courses, it is the responsibility of schools to afford teachers an opportunity to attend training. Moreover, the Government needs to ensure that professional development courses in pedagogical issues related to integrating ICT into instruction and learning are regularly made available to teachers.

5.3.5 Context of findings

Previous studies have ascribed the low integration of ICT in instruction and learning to factors such as a lack of ICT infrastructure and no access to computers. South African schools have a low access of 38% to computers and few South African schools (38%) have computers (Howie & Blignaut, 2009). In Israel over 40% of ICT coordinators face the challenge of having old and outdated computers (Nachmias, Mioduser & Forkosh-Baruch, 2010). Consequently these two countries [South Africa and Israel] have the lowest integration of ICT into instruction and learning among the SITES 2006 participating countries. However, other studies have shown that improving ICT infrastructure and computer access only is not enough to achieve the highest levels of ICT integration. For example, Bryderup, Larson and Trentel, (2009) contend that despite substantial improvements in terms of ICT infrastructure and computer access in Denmark there has been a negative development in the pedagogical use of ICT. This negative development is ascribed to policy changes that took place in Denmark (*ibid*). The model developed for this study identifies professional development as a key towards achieving 21st Century skills. However, there are several obstacles that affect professional development (expertise, ICT infrastructure, digital resources and time) and factors that affect professional development (system level, school level and teacher level factors). Previous studies have put emphasis only on the provision of ICT infrastructure, providing full access to computers, system level factors, school level factors and teacher level factors. This study puts more emphasis on developing teacher competence through professional development activities, but also highlights the obstacles that hinder professional development and factors that affect it..

Regarding the integration and the appropriate use of ICT in instruction and learning, professional development is a major prerequisite but unfortunately in many cases it is often overlooked (UNESCO, 2011). Furthermore, the "lack of effective professional development for teachers is often considered a root cause of the divide between what learners could potentially achieve and the reality they actually face in classrooms throughout the world" (*ibid*). The review of related literature reveals high quality professional development as the main solution to the challenges facing the integration and the appropriate use of ICT in teaching and learning (*ibid*). Schools cannot transform unless the teachers within them change; furthermore, long established culture and practices of organisations can hinder the implementation of new innovations and practices (*ibid*).

The findings support the proposed model in that although there are many teachers who experience a lack of ICT-related skills and pedagogical skills as an obstacle, a large proportion of those teachers are willing to attend professional development activities. In this scenario professional development is key towards improving teacher competencies and ICT integration in instruction and learning. Willing as these teachers may be, the Government should ensure that there are regular professional development opportunities for teachers, and schools should also afford teachers an opportunity to attend professional development activities.

5.4 Implications

One of the major challenges South Africa faces, in so far as integrating ICT in instruction and learning is concerned, is that a number of Science and Mathematics teachers experience a lack of ICT-related skills and a lack of pedagogical skills. Unlike previous studies that attribute the low ICT integration in South African classrooms to a lack of ICT infrastructure and low access to computers, this study looks beyond ICT infrastructure and access to computers. The model developed in this study will help policy makers, schools and teachers realise that to improve ICT integration in instruction and learning developments in ICT infrastructure and computer access should match the development of 21st Century skills through professional development.

5.4.1 Theoretical implications

The theoretical framework developed in this study contributes in several ways to the research community. Firstly, the framework puts professional development at the heart of developing 21st Century skills. Other researchers can expand on the other obstacles (ICT infrastructure, digital resources and time) that stand in the way of professional development that have not been explored in this study. This study concentrates on expertise only, which relates to whether or not teachers possess the necessary ICT and pedagogical skills. Secondly, the framework can serve as a framework for developing a holistic policy for ensuring maximum integration of ICT in instruction and learning.

5.4.2 Practical implications

The results of the current study are relevant to those who develop professional development activities for teachers. The framework can help these people to take into account the obstacles that hinder professional development and the factors that affect professional development to ensure that the professional development activities are a success. Eventually this should result in more teachers with the required ICT and pedagogic skills, which in turn could lead to a higher integration of ICT in instruction and learning.

5.5 Conclusions

The aim of this secondary data analysis study is to explore the training needs of South African Science and Mathematics teachers relating to ICT and their willingness to be trained. The need for this current study was driven by the lowest ICT integration of South Africa among the SITES 2006 participating countries (16% for Science and 18% for Mathematics). The results of the study indicate that there is a great need for the training of South African teachers. This is because 55% South African Science and Mathematics teachers experience a lack of ICT-related skills as an obstacle, and 62% South African Science and Mathematics teachers experience a lack of pedagogical skills as an obstacle. On a positive note the teachers who experience a lack of ICT-related and pedagogical skills are willing to attend professional development activities if available. Professional development is key towards equipping teachers with 21st Century skills so that they become more proficient in their practice. The framework put forth by this study recognises professional development as the most important element to realise the development of 21st Century skills. It can be used by both policy makers and professional development activities developers as a framework for developing policies and professional development activities aimed at improving 21st Century skills. Before professional development activities can be undertaken there is a great need for taking into consideration the obstacles that may stand in the way of professional development. These obstacles include a lack of expertise, ICT infrastructure, digital resources and time. There are also factors such as system level, teacher level and school level factors that affect professional development. Future researchers can expand on the other obstacles and factors presented in the model that have not been considered in this study.

5.6 Recommendations

In order to ensure that South African Science and Mathematics teachers' training needs are addressed it is important to make sure that professional development activities that are both relevant and subject-specific are regularly available. The Government should encourage teachers to attend professional development activities. This can be done by providing incentives to teachers to attend such activities and by providing rewards to teachers who have attended them. The Government should also devise means of ensuring that teachers integrate ICT into their daily preparation and teaching activities. For instance, teachers may be required to upload their lesson plans and schemes of work in regional and national online databases. Finally, only teachers with teaching licences should be employed and teaching licences should only be issued to teachers with the required ICT and pedagogical skills.

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ADDENDA

Addendum A

Addendum A1

Gender distribution

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	Male	572	44.4	46.0	46.0
	Female	671	52.1	54.0	100.0
	Total	1243	96.5	100.0	
Missing	Not reached	7	.5		
	Omitted	38	3.0		
	Total	45	3.5		
Total		1288	100.0		

Addendum A 1.1

Test statistics

	Gender distribution
Chi-Square	7.885[a]
df	1
Asymp. Sig.	.005

a. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 621.5.

Addendum A 2

Age groups

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	Under 25	37	2.9	3.0	3.0
	25 - 29	155	12.0	12.5	15.5
	30 - 39	516	40.1	41.7	57.2
	40 - 49	404	31.4	32.6	89.8
	50 - 59	110	8.5	8.9	98.7
	60 years or over	16	1.2	1.3	100.0
	Total	1238	96.1	100.0	
Missing	Not reached	7	.5		
	Omitted	43	3.3		
	Total	50	3.9		
Total		1288	100.0		

Addendum A 2.1

Test statistics

	Age groups
Chi-Square	1026.404[a]
df	5
Asymp. Sig.	.000

a. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 206.3.

Addendum A 3

Level of education

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	Secondary or high school	39	3.0	3.1	3.1
	Post-secondary education	677`	52.6	54.0	57.1
	Bachelor's degree	353	27.4	28.2	85.3
	Master's degree or higher	184	14.3	14.7	100.0
	Total	1253	97.3	100.0	
Missing	Not reached	7	.5		
	Omitted	28	2.2		
	Total	35	2.7		
Total		1288	100.0		

Addendum A 3.1

Test statistics

	Level of education
Chi-Square	720.871[a]
df	3
Asymp. Sig.	.000

a. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 313.3.

Addendum A 4

Years of teaching experience

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	Less than 2 years	136	10.6	10.6	10.6
	2 - 4 years	233	18.1	18.2	28.9
	5 - 9 years	259	20.1	20.3	49.2
	10 - 19 years	451	35.0	35.3	84.5
	20 years or more	198	15.4	15.5	100.0
	Total	1277	99.1	100.0	
Missing	Not reached	7	.5		
	Omitted	4	.3		
	Total	11	.9		
Total		1288	100.0		

Addendum A 4.1

Test statistics

	Years of teaching experience
Chi-Square	220.537[a]
df	4
Asymp. Sig.	.000

a. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 255.4.

Addendum A 5

Access to a computer at home

		Frequency	Percentage	Valid Percentage	Cumulative Percent
Valid	No	462	35.9	42.3	42.3
	Yes	629	48.8	57.7	100.0
	Total	1091	84.7	100.0	
Missing	Not reached	7	.5		
	Omitted	190	14.8		
	Total	197	15.3		
Total		1288	100.0		

Addendum A 5.1

Test statistics

	Access to a computer at home
Chi-Square	25.563[a]
df	1
Asymp. Sig.	.000

a. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 545.5.

Addendum A 6

Bachelor's degree

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	No	957	74.3	75.7	75.7
	Degree in Mathematics only	83	6.4	6.6	82.3
	Degree in Science only	118	9.2	9.3	91.6
	Degree in both Mathematics and Science	106	8.2	8.4	100.0
	Total	1264	98.1	100.0	
Missing	Not reached	7	.5		
	Omitted	17	1.3		
	Total	24	1.9		
Total		1288	100.0		

Addendum A 6.1

Test statistics

	Bachelor's degree
Chi-Square	1735.677[a]
df	3
Asymp. Sig.	.000

a. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 316.0.

Addendum A 7

Teaching licence or certificate

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	No	123	9.5	9.7	9.7
	Yes	1140	88.5	90.3	100.0
	Total	1263	98.1	100.0	
Missing	Not reached	7	.5		
	Omitted	18	1.4		
	Total	25	1.9		
Total		1288	100.0		

Addendum A 7.1

Test statistics

	Teaching licence or certificate
Chi-Square	818.914[a]
df	1
Asymp. Sig.	.000

a. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 631.5.

Addendum A 8

Experience A lack of required ICT skills as an obstacle

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	No	537	41.7	44.7	44.7
	Yes	664	51.6	55.3	100.0
	Total	1201	93.2	100.0	
Missing	Not reached	6	.5		
	Omitted	81	6.3		
	Total	87	6.8		
Total		1288	100.0		

Addendum A 8.1

Test statistics

	Experience a lack of required ICT skill as an obstacle
Chi-Square	13.430[a]
df	1
Asymp. Sig.	.000

a. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 600.5.

Addendum A 9

Access to computer at home and experience a lack of required ICT skills as an obstacle cross tabulation

		Experience a lack of required ICT skills as an obstacle		Total
		No	Yes	
Access to a computer at home	No	146	293	439
	Yes	310	292	602
Total		456	585	1041

Addendum A 9.1

Chi-square tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson chi-square	34.303[a]	1	.000		
Continuity Correction[b]	33.566	1	.000		
Likelihood ratio	34.699	1	.000		
Fisher's exact test				.000	.000
Linear-by-linear association	34.270	1	.000		
N of valid cases	1041				

a. 0 cells (.0%) have an expected count less than 5. The minimum expected count is 192.30.
b. Computed only for a 2 X 2 table.

Addendum A 9.2

Probability calculations

		Experience a lack of required ICT skills as an obstacle		Total
		No	Yes	
Access to a computer at home	No	0.14	0.28	0.42
	Yes	0.30	0.28	0.58
Total		0.44	0.56	1.00

Addendum A 10

Age groups and experience a lack of required ICT skills as an obstacle cross tabulation

		Experience a lack of required ICT skills as an obstacle		Total
		No	Yes	
Age group	Under 40	330	343	673
	Over 40	198	312	510
Total		528	655	1183

Addendum A 10.1

Chi-square tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson chi-square	12.241[a]	1	.000		
Continuity correction[b]	11.831	1	.001		
Likelihood ratio	12.290	1	.000		
Fisher's exact test				.000	.000
Linear-by-linear association	12.230	1	.000		
N of valid cases	1183				

a. 0 cells (.0%) have an expected count less than 5. The minimum expected count is 227.62.
b. Computed only for a 2 X 2 table.

Addendum A 10.2

Probability calculations

		Experience a lack of required ICT skills as an obstacle		Total
		No	Yes	
Age group	Under 40	0.28	0.29	0.57
	Over 40	0.17	0.26	0.43
Total		0.45	0.55	1.00

Addendum A 11

Gender and experience a lack of required ICT skills as an obstacle Cross tabulation

		Experience a lack of required ICT skills as an obstacle		Total
		No	Yes	
Gender	Male	252	299	551
	Female	278	357	635
Total		530	656	1186

Addendum A 11.1

Chi-square tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson chi-square	.456[a]	1	.499		
Continuity correction[b]	.381	1	.537		
Likelihood ratio	.456	1	.499		
Fisher's exact test				.520	.269
Linear-by-linear association	.456	1	.499		
N of valid cases	1186				

a. 0 cells (.0%) have an expected count less than 5. The minimum expected count is 246.23.
b. Computed only for a 2 X 2 table.

Addendum A 11.2

Probability calculations

		Experience a lack of required ICT skills as an obstacle		
		No	Yes	Total
Gender	Male	0.21	0.25	0.46
	Female	0.23	0.30	0.54
Total		0.45	0.55	1.00

Addendum A 12

level of education and experience a lack of required ICT skills as an obstacle cross tabulation

		Experience a lack of required ICT skills as an obstacle		Total
		No	Yes	
Level of education	Undergraduates	429	567	996
	Postgraduates	98	80	178
Total		527	647	1174

Addendum A 12.1

Chi-square tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson chi-square	8.767[a]	1	.003		
Continuity correction[b]	8.289	1	.004		
Likelihood ratio	8.718	1	.003		
Fisher's exact test				.003	.002
Linear-by-linear association	8.759	1	.003		
N of valid cases	1174				

a. 0 cells (.0%) have an expected count less than 5. The minimum expected count is 79.90.
b. Computed only for a 2 X 2 table.

Addendum A 12.2

Probability calculations

		Experience a lack of required ICT skill as an obstacle		
		No	Yes	Total
Level of education	Undergraduates	0.37	0.48	0.85
	Postgraduates	0.08	0.07	0.15
Total		0.45	0.55	1.00

Addendum A 13

Bachelor's degree and experience a lack of required ICT skills as an obstacle cross tabulation

		Experience a lack of required ICT skills as an obstacle		Total
		No	Yes	
Bachelor's Degree	No Degree	363	536	899
	Degree in Maths / Science or both	168	120	288
Total		531	656	1187

Addendum A 13.1

Chi-square tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson chi-square	28.443[a]	1	.000		
Continuity correction[b]	27.722	1	.000		
Likelihood ratio	28.350	1	.000		
Fisher's exact test				.000	.000
Linear-by-linear association	28.419	1	.000		
N of valid cases	1187				

a. 0 cells (.0%) have an expected count less than 5. The minimum expected count is 128.84.
b. Computed only for a 2 X 2 table.

Addendum A 13.2

Probability calculations

		Experience a lack of required ICT skills as an obstacle		Total
		No	Yes	
Bachelor's Degree	No degree	0.31	0.45	0.76
	Degree in Maths / Science or both	0.14	0.10	0.24
Total		0.45	0.55	1.00

Addendum A 14

Teaching licence or certificate and experience a lack of required ICT skills as an obstacle cross tabulation

		Experience a lack of required ICT skills as an obstacle		Total
		No	Yes	
Teaching licence or certificate	No	57	55	112
	Yes	473	602	1075
Total		530	657	1187

Addendum A 14.1

Chi-square tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson chi-square	1.950[a]	1	.163		
Continuity correction[b]	1.681	1	.195		
Likelihood ratio	1.939	1	.164		
Fisher's exact test				.164	.098
Linear-by-linear association	1.948	1	.163		
N of valid cases	1187				

a. 0 cells (.0%) have an expected count less than 5. The minimum expected count is 50.01.
b. Computed only for a 2 X 2 table.

Addendum A 14.2

Probability calculations

		Experience lack of required ICT skill as an obstacle		Total
		No	Yes	
Teaching licence or certificate	No	0.04	0.05	0.09
	Yes	0.40	0.51	0.91
Total		0.45	0.56	1.00

Addendum A 15

Years of experience teaching and experience a lack of required ICT skills as an obstacle cross tabulation

		Experience a lack of required ICT skills as an obstacle		Total
		No	Yes	
Years of teaching experience	Less than 10 years	293	291	584
	More than 10 years	243	370	613
Total		536	661	1197

Addendum A 15.1

Chi-square tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson chi-square	13.411[a]	1	.000		
Continuity correction[b]	12.989	1	.000		
Likelihood ratio	13.433	1	.000		
Fisher's exact test				.000	.000
Linear-by-linear association	13.400	1	.000		
N of valid cases	1197				

a. 0 cells (.0%) have an expected count less than 5. The minimum expected count is 261.51.

b. Computed only for a 2 X 2 table.

Addendum A 15.2

Probability calculations

		Experience a lack of required ICT skills as an obstacle		Total
		No	Yes	
Years of teaching experience	Less than 10 years	0.24	0.25	0.49
	More than 10 years	0.20	0.31	0.51
Total		0.44	0.56	1.00

Addendum A 16

Willingness to attend an introductory course in internet

		Frequency	Percentage	Valid Percentage	Cumulative Percent
Valid	No, I do not wish to attend	20	3.0	3.1	3.1
	No, I would like to attend if available	546	82.2	83.6	86.7
	Yes, I have attended	87	13.1	13.3	100.0
	Total	653	98.3	100.0	
Missing	Omitted	3	.5		
	System	8	1.2		
	Total	11	1.7		
Total		664	100.0		

Addendum A 16.1

Test statistics

	Willingness to attend an introductory course in internet
Chi-Square	753.210[a]
df	2
Asymp. Sig.	.000

a. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 217.7.

Addendum A 17

Access to computer at home and willingness to attend an introductory course in internet cross tabulation

		Willingness to attend an introductory course in internet			Total
		No, I do not wish to attend	No, I would like to attend if available	Yes, I have attended	
Access to a computer at home	No	6	254	27	287
	Yes	13	230	46	289
Total		19	484	73	576

Addendum A 17.1

Chi-square tests

	Value	df	Asymp. Sig. (2-sided)
Pearson chi-square	8.707[a]	2	.013
Likelihood ratio	8.827	2	.012
Linear-by-linear association	1.602	1	.206
N of valid cases	576		

a. 0 cells (.0%) have an expected count less than 5. The minimum expected count is 9.47.

Addendum A 18

Age groups and willingness to attend an introductory course in internet cross tabulation

		Willingness to attend an introductory course in internet			Total
		No, I do not wish to attend	No, I would like to attend if available	Yes, I have attended	
Age group	Under 40	9	286	47	342
	Over 40	11	253	38	302
Total		20	539	85	644

Addendum A 18.1

Chi-square tests

	Value	df	Asymp. Sig. (2-sided)
Pearson chi-square	.692[a]	2	.708
Likelihood ratio	.691	2	.708
Linear-by-linear association	.494	1	.482
N of valid cases	644		

a. 0 cells (.0%) have an expected count less than 5. The minimum expected count is 9.38.

Addendum A 19

Gender and willingness to attend an introductory course in internet cross tabulation

		Willingness to attend an introductory course in internet			Total
		No, I do not wish to attend	No, I would like to attend if available	Yes, I have	
Gender	Male	4	252	34	290
	Female	16	287	52	355
Total		20	539	86	645

Addendum A 19.1

Chi-square tests

	Value	df	Asymp. Sig. (2-sided)
Pearson chi-square	6.758[a]	2	.034
Likelihood ratio	7.218	2	.027
Linear-by-linear association	.004	1	.948
N of valid cases	645		

a. 0 cells (.0%) have an expected count less than 5. The minimum expected count is 8.99.

Addendum A 20

Level of education and willingness to attend an introductory course in internet cross tabulation

		Willingness to attend an introductory course in internet			Total
		No, I do not wish to attend	No, I would like to attend if available	Yes, I have attended	
Level of education	Undergraduates	15	473	72	560
	Postgraduates	3	64	11	78
Total		18	537	83	638

Addendum A 20.1

Chi-square tests

	Value	df	Asymp. Sig. (2-sided)
Pearson chi-square	.460[a]	2	.795
Likelihood ratio	.429	2	.807
Linear-by-linear association	.000	1	.987
N of valid cases	638		

a. 1 cells (16.7%) have an expected count less than 5. The minimum expected count is 2.20.

Addendum A 21

Bachelor's degree and willingness to attend an introductory course in internet cross tabulation

		Willingness to attend an introductory course in internet			Total
		No, I do not wish to attend	No, I would like to attend if available	Yes, I have attended	
Bachelor's Degree	No degree	11	453	62	526
	Degree in Maths / Science or both	9	87	23	119
Total		20	540	85	645

Addendum A 21.1

Chi-square tests

	Value	df	Asymp. Sig. (2-sided)
Pearson chi-square	15.520[a]	2	.000
Likelihood ratio	13.197	2	.001
Linear-by-linear association	.272	1	.602
N of valid cases	645		

a. 1 cells (16.7%) have an expected count less than 5. The minimum expected count is 3.69.

Addendum A 22

Teaching licence or certificate and willingness to attend an introductory course in internet cross tabulation

		Willingness to attend an introductory course in internet			Total
		No, I do not wish to attend	No, I would like to attend if available	Yes, I have attended	
Teaching licence or certificate	No	2	46	6	54
	Yes	18	497	78	593
Total		20	543	84	647

Addendum A 22.1

Chi-square tests

	Value	df	Asymp. Sig. (2-sided)
Pearson chi-square	.242[a]	2	.886
Likelihood ratio	.245	2	.885
Linear-by-linear association	.241	1	.624
N of valid cases	647		

a. 1 cell (16.7%) has an expected count less than 5. The minimum expected count is 1.67.

Addendum A 23

Years of teaching experience and willingness to attend an introductory course in internet cross tabulation

		Willingness to attend an introductory course in internet			Total
		No, I do not wish to attend	No, I would like to attend if available	Yes, I have attended	
Years of teaching experience	Less than 10 years	10	233	46	289
	More than 10 years	10	311	40	361
Total		20	544	86	650

Addendum A 23.1

Chi-square tests

	Value	df	Asymp. Sig. (2-sided)
Pearson chi-square	3.672[a]	2	.159
Likelihood ratio	3.650	2	.161
Linear-by-linear association	1.804	1	.179
N of valid cases	650		

a. 0 cells (.0%) have an expected count less than 5. The minimum expected count is 8.89.

Addendum A 24

Willingness to attend an advanced course for applications

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	No, I do not wish to attend	43	6.5	6.5	6.5
	No, I would like to attend if available	585	88.1	89.0	95.6
	Yes, I have attended	29	4.4	4.4	100.0
	Total	657	98.9	100.0	
Missing	Omitted	2	.3		
	System	5	.8		
	Total	7	1.1		
Total		664	100.0		

Addendum A 24.1

Test statistics

	Willingness to attend an advanced course for applications
Chi-Square	917.954[a]
df	2
Asymp. Sig.	.000

a. 0 cells (0.0%) have an expected frequency less than 5. The minimum expected cell frequency is 219.0.

Addendum A 25

Access to computer at home and willingness to attend an advanced course for applications cross tabulation

		Willingness to attend an advanced course for applications			Total
		No, I do not wish to attend	No, I would like to attend if available	Yes, I have attended	
Access to a computer at home	No	12	264	11	287
	Yes	29	250	12	291
Total		41	514	23	578

Addendum A 25.1

Chi-square tests

	Value	df	Asymp. Sig. (2-sided)
Pearson chi-square	7.446[a]	2	.024
Likelihood ratio	7.663	2	.022
Linear-by-linear association	3.966	1	.046
N of valid cases	578		

a. 0 cells (.0%) have an expected count less than 5. The minimum expected count is 11.42.

Addendum A 26

Age groups and willingness to attend an advanced course for applications cross tabulation

		Willingness to attend an advanced course for applications			Total
		No, I do not wish to attend	No, I would like to attend if available	Yes, I have attended	
Age group	Under 40	16	307	19	342
	Over 40	27	269	10	306
Total		43	576	29	648

Addendum A 26.1

Chi-square tests

	Value	df	Asymp. Sig. (2-sided)
Pearson chi-square	6.133[a]	2	.047
Likelihood ratio	6.193	2	.045
Linear-by-linear association	6.031	1	.014
N of valid cases	648		

a. 0 cells (.0%) have an expected count less than 5. The minimum expected count is 13.69.

Addendum A 27

Gender and willingness to attend an advanced course for applications cross tabulation

		Willingness to attend an advanced course for applications			Total
		No, I do not wish to attend	No, I would like to attend if available	Yes, I have attended	
Gender	Male	6	269	18	293
	Female	37	308	11	356
Total		43	577	29	649

Addendum A 27.1

Chi-square tests

	Value	df	Asymp. Sig. (2-sided)
Pearson chi-square	20.755[a]	2	.000
Likelihood ratio	23.076	2	.000
Linear-by-linear association	18.874	1	.000
N of valid cases	649		

a. 0 cells (.0%) have an expected count less than 5. The minimum expected count is 13.09.

Addendum A 28

Level of education and willingness to attend an advanced course for applications cross tabulation

		Willingness to attend an advanced course for applications			Total
		No, I do not wish to attend	No, I would like to attend if available	Yes, I have attended	
Level of education	Undergraduates	34	505	24	563
	Postgraduates	6	68	4	78
Total		40	573	28	641

Addendum A 28.1

Chi-square tests

	Value	df	Asymp. Sig. (2-sided)
Pearson chi-square	.466[a]	2	.792
Likelihood ratio	.443	2	.801
Linear-by-linear association	.040	1	.841
N of valid cases	641		

a. 2 cells (33.3%) have an expected count less than 5. The minimum expected count is 3.41.

Addendum A 29

Bachelor's degree and willingness to attend an advanced course for applications cross tabulation

		Willingness to attend an advanced course for applications			Total
		No, I do not wish to attend	No, I would like to attend if available	Yes, I have attended	
Bachelor's Degree	No degree	27	480	22	529
	Degree in Maths / Science or both	16	98	6	120
Total		43	578	28	649

Addendum A 29.1

Chi-square tests

	Value	df	Asymp. Sig. (2-sided)
Pearson chi-square	11.062[a]	2	.004
Likelihood ratio	9.367	2	.009
Linear-by-linear association	4.897	1	.027
N of valid cases	649		

a. 0 cells (.0%) have an expected count less than 5. The minimum expected count is 5.18.

Addendum A 30

Teaching licence or certificate and willingness to attend an advanced course for applications cross tabulation

		Willingness to attend an advanced course for applications			Total
		No, I do not wish to attend	No, I would like to attend if available	Yes, I have attended	
Teaching licence or certificate	No	2	51	1	54
	Yes	41	527	28	596
Total		43	578	29	650

Addendum A 30.1

Chi-square tests

	Value	df	Asymp. Sig. (2-sided)
Pearson chi-square	1.856[a]	2	.395
Likelihood ratio	2.218	2	.330
Linear-by-linear association	.005	1	.944
N of valid cases	650		

a. 2 cells (33.3%) have expected count less than 5. The minimum expected count is 2.41.

Addendum A 31

Years of experience teaching and willingness to attend an advanced course for applications cross tabulation

		Willingness to attend an advanced course for applications			Total
		No, I do not wish to attend	No, I would like to attend if available	Yes, I have attended	
Years of teaching experience	Less than 10 years	17	254	17	288
	More than 10 years	26	328	12	366
Total		43	582	29	654

Addendum A 31.1

Chi-square tests

	Value	df	Asymp. Sig. (2-sided)
Pearson chi-square	2.893[a]	2	.235
Likelihood ratio	2.874	2	.238
Linear-by-linear association	2.148	1	.143
N of valid cases	654		

a. 0 cells (.0%) have an expected count less than 5. The minimum expected count is 12.77.

Addendum A 32

Experience a lack of pedagogical skills as an obstacle

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	No	455	35.3	38.0	38.0
	Yes	742	57.6	62.0	100.0
	Total	1197	92.9	100.0	
Missing	Not reached	6	.5		
	Omitted	84	6.5		
	System	1	.1		
	Total	91	7.1		
Total		1288	100.0		

Addendum A 32.1

Test statistics

	Experience a lack of pedagogical skills as an obstacle
Chi-Square	68.813[a]
df	1
Asymp. Sig.	.000

a. 0 cells (.0%) have an expected count less than 5. The minimum expected cell frequency is 598.5.

Addendum A 33

Access to computer at home and experience a lack of pedagogical skills as an obstacle cross tabulation

		Experience a lack of pedagogical skills as an obstacle		Total
		No	Yes	
Access to a computer at home	No	128	313	441
	Yes	250	348	598
Total		378	661	1039

Addendum A 33.1

Chi-square tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson chi-square	7.184[a]	1	.007		
Continuity correction[b]	6.648	1	.010		
Likelihood ratio	6.998	1	.008		
Fisher's exact test				.008	.005
Linear-by-linear association	7.178	1	.007		
N of valid cases	1184				

a. 0 cells (.0%) have an expected count less than 5. The minimum expected count is 42.85.
b. Computed only for a 2 X 2 table.

Addendum A 33.2

Probability calculations

		Experience a lack of pedagogical skills as an obstacle		
		No	Yes	Total
Access to a computer at home	No	0.12	0.30	0.42
	Yes	0.24	0.33	0.58
Total		0.36	0.64	1.00

Addendum A 34

Age groups and experience a lack of pedagogical skills as an obstacle cross tabulation

		Experience a lack of pedagogical skills as an obstacle		Total
		No	Yes	
Age group	Under 40	288	386	674
	Over 40	159	346	505
Total		447	732	1179

Addendum A 34.1

Chi-square tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson chi-square	15.508[a]	1	.000		
Continuity Correction[b]	15.034	1	.000		
Likelihood ratio	15.641	1	.000		
Fisher's exact test				.000	.000
Linear-by-linear association	15.495	1	.000		
N of valid cases	1179				

a. 0 cells (.0%) have an expected count less than 5. The minimum expected count is 191.46.
b. Computed only for a 2 X 2 table.

Addendum A 34.2

Probability calculations

		Experience a lack of pedagogical skills as an obstacle		Total
		No	Yes	
Age group	Under 40	0.24	0.33	0.57
	Over 40	0.13	0.29	0.43
Total		0.38	0.62	1.00

Addendum A 35

Gender and experience a lack of pedagogical skills as an obstacle cross tabulation

		Experience a lack of pedagogical skills as an obstacle		Total
		No	Yes	
Gender	Male	215	335	550
	Female	235	397	632
Total		450	732	1182

Addendum A 35.1

Chi-square tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson chi-square	.454[a]	1	.501		
Continuity Correction[b]	.376	1	.539		
Likelihood ratio	.454	1	.501		
Fisher's exact test				.509	.270
Linear-by-linear association	.453	1	.501		
N of valid cases	1182				

a. 0 cells (.0%) have an expected count less than 5. The minimum expected count is 209.39.

b. Computed only for a 2 X 2 table.

Addendum A 35.2

Probability calculations

		Experience a lack of pedagogical skills as an obstacle		
		No	Yes	Total
Gender	Male	0.18	0.28	0.47
	Female	0.20	0.34	0.53
Total		0.38	0.62	1.00

Addendum A 36

Level of education and experience a lack of pedagogical skills as an obstacle cross tabulation

		Experience a lack of pedagogical skills as an obstacle		Total
		No	Yes	
Level of education	Undergraduates	368	626	994
	Postgraduates	76	100	176
Total		444	726	1170

Addendum A 36.1

Chi-square tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson chi-square	2.409[a]	1	.121		
Continuity correction[b]	2.155	1	.142		
Likelihood ratio	2.379	1	.123		
Fisher's exact test				.130	.072
Linear-by-linear association	2.407	1	.121		
N of valid cases	1170				

a. 0 cells (.0%) have an expected count less than 5. The minimum expected count is 66.79.
b. Computed only for a 2 X 2 table.

Addendum A 36.2

Probability calculations

		Experience a lack of pedagogical skills as an obstacle		Total
		No	Yes	
Level of education	Undergraduates	0.31	0.54	0.85
	Postgraduates	0.06	0.09	0.15
Total		0.37	0.68	1.00

Addendum A 37

Bachelor's degree and experience a lack of pedagogical skills as an obstacle cross tabulation

		Experience a lack of pedagogical skills as an obstacle		Total
		No	Yes	
Bachelor's Degree	No degree	312	584	896
	Degree in Maths / Science or both	136	150	286
Total		448	734	1182

Addendum A 37.1

Chi-square tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson chi-square	14.929[a]	1	.000		
Continuity Correction[b]	14.393	1	.000		
Likelihood ratio	14.682	1	.000		
Fisher's exact test				.000	.000
Linear-by-linear association	14.917	1	.000		
N of valid cases	1182				

a. 0 cells (.0%) have an expected count less than 5. The minimum expected count is 108.40.
b. Computed only for a 2 X 2 table.

Addendum A 37.2

Probability calculations

		Experience a lack of pedagogical skills as an obstacle		Total
		No	Yes	
Bachelor's Degree	No degree	0.26	0.49	0.76
	Degree in Maths / Science or both	0.12	0.13	0.24
Total		0.38	0.62	1.00

Addendum A 38

Teaching licence or certificate and experience a lack of pedagogical skills as an obstacle cross tabulation

		Experience a lack of pedagogical skills as an obstacle		Total
		No	Yes	
Teaching licence or certificate	No	56	57	113
	Yes	393	678	1071
Total		449	735	1184

Addendum A 38.1

Chi-square tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson chi-square	7.184[a]	1	.007		
Continuity Correction[b]	6.648	1	.010		
Likelihood ratio	6.998	1	.008		
Fisher's exact test				.008	.005
Linear-by-linear association	7.178	1	.007		
N of valid cases	1184				

a. 0 cells (.0%) have an expected count less than 5. The minimum expected count is 42.85.

b. Computed only for a 2 X 2 table.

Addendum A 38.2

Probability calculations

		Experience a lack of pedagogical skills as an obstacle: No	Experience a lack of pedagogical skills as an obstacle: Yes	Total
Teaching licence or certificate	No	0.05	0.05	0.10
	Yes	0.33	0.57	0.90
Total		0.38	0.62	1.00

Addendum A 39

Years of teaching experience and experience a lack of pedagogical skills as an obstacle cross tabulation

		Experience a lack of pedagogical skills as an obstacle: No	Experience a lack of pedagogical skills as an obstacle: Yes	Total
Years of teaching experience	Less than 10 years	252	331	583
	More than 10 years	202	408	610
Total		454	739	1193

Addendum A 39.1

Chi-square tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson chi-square	12.925[a]	1	.000		
Continuity correction[b]	12.500	1	.000		
Likelihood ratio	12.944	1	.000		
Fisher's exact test				.000	.000
Linear-by-linear association	12.914	1	.000		
N of valid cases	1193				

a. 0 cells (.0%) have an expected count less than 5. The minimum expected count is 221.86.
b. Computed only for a 2 X 2 table.

Addendum A 39.2

Probability calculations

		Experience a lack of pedagogical skills as an obstacle		Total
		No	Yes	
Years of teaching experience	Less than 10 years	0.21	0.28	0.49
	More than 10 years	0.17	0.34	0.51
Total		0.38	0.62	1.00

Addendum A 40

Willingness to attend a course on pedagogical issues

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	No, I do not wish to attend	22	3.0	3.0	3.0
	No, I would like to attend if available	681	91.8	92.5	95.5
	Yes, I have attended	33	4.4	4.5	100.0
	Total	736	99.2	100.0	
Missing	OMITTED	6	.8		
Total		742	100.0		

Addendum A 40.1

Test statistics

	Willingness to attend a course on pedagogical issues
Chi-square	1160.742[a]
df	2
Asymp. Sig.	.000

a. 0 cells (0.0%) have expected frequencies less than 5. The minimum expected cell frequency is 245.3.

Addendum A 41

Access to computer at home and willingness to attend a course on pedagogical issues cross tabulation

		Willingness to attend a course on pedagogical issues			Total
		No, I do not wish to attend	No, I would like to attend if available	Yes, I have attended	
Access to a computer at home	No	10	287	11	308
	Yes	10	321	16	347
Total		20	608	27	655

Addendum A 41.1

Chi-square tests

	Value	df	Asymp. Sig. (2-sided)
Pearson chi-square	.507[a]	2	.776
Likelihood ratio	.510	2	.775
Linear-by-linear association	.449	1	.503
N of valid cases	655		

a. 0 cells (.0%) have an expected count less than 5. The minimum expected count is 9.40.

Addendum A 42

Age groups and willingness to attend a course on pedagogical issues cross tabulation

		Willingness to attend a course on pedagogical issues			Total
		No, I do not wish to attend	No, I would like to attend if available	Yes, I have attended	
Age group	Under 40	15	347	23	385
	Over 40	7	324	10	341
Total		22	671	33	726

Addendum A 42.1

Chi-square tests

	Value	df	Asymp. Sig. (2-sided)
Pearson chi-square	6.175[a]	2	.046
Likelihood ratio	6.360	2	.042
Linear-by-linear association	.343	1	.558
N of valid cases	726		

a. 0 cells (.0%) have an expected count less than 5. The minimum expected count is 10.33.

Addendum A 43

Gender and willingness to attend a course on pedagogical issues cross tabulation

		Willingness to attend a course on pedagogical issues			Total
		No, I do not wish to attend	No, I would like to attend if available	Yes, I have attended	
Gender	Male	7	306	17	330
	Female	15	365	16	396
Total		22	671	33	726

Addendum A 43.1

Chi-square tests

	Value	df	Asymp. Sig. (2-sided)
Pearson chi-square	2.145[a]	2	.342
Likelihood ratio	2.193	2	.334
Linear-by-linear association	1.836	1	.175
N of valid cases	726		

a. 0 cells (.0%) have an expected count less than 5. The minimum expected count is 10.00.

Addendum A 44

Level of education and willingness to attend a course on pedagogical issues cross tabulation

		Willingness to attend a course on pedagogical issues			Total
		No, I do not wish to attend	No, I would like to attend if available	Yes, I have attended	
Level of education	Undergraduates	13	579	31	623
	Postgraduates	8	88	2	98
	Total	21	667	33	721

Addendum A 44.1

Chi-square tests

	Value	df	Asymp. Sig. (2-sided)
Pearson chi-square	12.419[a]	2	.002
Likelihood ratio	9.861	2	.007
Linear-by-linear association	9.203	1	.002
N of valid cases	721		

a. 2 cells (33.3%) have an expected count less than 5. The minimum expected count is 2.85.

Addendum A 45

Bachelor's degree and willingness to attend a course on pedagogical issues cross tabulation

		Willingness to attend a course on pedagogical issues			Total
		No, I do not wish to attend	No, I would like to attend if available	Yes, I have attended	
Bachelor's Degree	No degree	14	536	28	578
	Degree in Maths / Science or both	8	138	4	150
Total		22	674	32	728

Addendum A 45.1

Chi-square tests

	Value	df	Asymp. Sig. (2-sided)
Pearson chi-square	4.632[a]	2	.099
Likelihood ratio	4.346	2	.114
Linear-by-linear association	4.163	1	.041
N of valid cases	728		

a. 1 cells (16.7%) have an expected count less than 5. The minimum expected count is 4.53.

Addendum A 46

Teaching licence or certificate and willingness to attend a course on pedagogical issues cross tabulation

		Willingness to attend a course on pedagogical issues			Total
		No, I do not wish to attend	No, I would like to attend if available	Yes, I have attended	
Possess a teaching licence or certificate	No	0	55	2	57
	Yes	22	619	31	672
Total		22	674	33	729

Addendum A 46.1

Chi-square tests

	Value	df	Asymp. Sig. (2-sided)
Pearson chi-square	2.117[a]	2	.347
Likelihood ratio	3.842	2	.146
Linear-by-linear association	.328	1	.567
N of valid cases	729		

a. 2 cells (33.3%) have an expected count less than 5. The minimum expected count is 1.72.

Addendum A 47

Years of teaching experience and willingness to attend a course on pedagogical issues cross tabulation

		Willingness to attend a course on pedagogical issues			Total
		No, I do not wish to attend	No, I would like to attend if available	Yes, I have attended	
Years of teaching experience	Less than 10 years	10	298	21	329
	More than 10 years	12	380	12	404
Total		22	678	33	733

Addendum A 47.1

Chi-square tests

	Value	df	Asymp. Sig. (2-sided)
Pearson chi-square	4.931[a]	2	.085
Likelihood ratio	4.922	2	.085
Linear-by-linear association	2.706	1	.100
N of valid cases	733		

a. 0 cells (.0%) have an expected count less than 5. The minimum expected count is 9.87.

Addendum B

23. **Do you experience the following obstacles in using ICT in your teaching?**
Please mark only one choice in each row.

	2 No	2 Yes
A. ICT is not considered to be useful in my school. BTG23A1	☐	☐
B. My school does not have the required ICT infrastructure. BTG23B1	☐	☐
C. I do not have the required ICT-related skills. BTG23C1	☐	☐
D. I do not have the necessary ICT-related pedagogical skills. BTG23D1	☐	☐
E. I do not have sufficient confidence to try the new approaches alone. BTG23E1	☐	☐
F. My students do not possess the required ICT skills. BTG23G1	☐	☐
G. My students do not have access to the required ICT tools outside of the school premises . BTG23G1	☐	☐
H. I do not have the time necessary to develop and implement the activities BTG23H1	☐	☐
I. I do not know how to identify which ICT tools will be useful. BTG23I1	☐	☐
J. My school lacks digital learning resources. BTG23J1	☐	☐
K. I do not have the flexibility to make my own decisions when planning lessons with ICT. BTG23K1	☐	☐
L. I do not have access to ICT outside of the school. BTG23L1	☐	☐

24. **Have you participated in any of the following professional development activities? If no, would you wish to attend?**
Please mark only one choice in each row.

	1 No, I do Not wish to attend	2 No, I would like to attend if available	3 Yes, I have
B. Introductory course in Internet use and general applications (e.g., basic word-processing, spreadsheets, databases, etc.). BTG24A1	☐	☐	☐
B. Technical course in operating and maintaining computer systems. BTG24B1	☐	☐	☐
C. Advanced course in applications / standard tools (e.g., advanced word-processing, complex relational databases, etc.). BTG24C1	☐	☐	☐
D. Advanced course in Internet use (e.g., creating websites / developing a home page, advanced use of the Internet, video conferencing). BTG24D1	☐	☐	☐
E. Course on pedagogical issues related to integrating ICT into teaching and learning. BTG24E1	☐	☐	☐
F. Subject-specific training with learning software for specific content goals (e.g., tutorials, simulation, etc.). BTG24F1	☐	☐	☐
G. Course in multimedia operations (e.g., using digital video and / or audio equipment)	☐	☐	☐

Addendum C

29. Do you have access to a computer at home?

BTG29A1 Filter

1 ☐ No → Please go to question 31.

2 ☐ Yes → Please continue.

31. To what age group do you belong?

BTG31A1

1	2	3	4	5	6
Below 25	25–29	30–39	40–49	50–59	60 or above
☐	☐	☐	☐	☐	☐

32. What is your gender?

BTG32A1

1	2
Male	Female
☐	☐

33. What is your highest level of education?

BTG33A1

Please mark only one choice.

1	2	3	4
Secondary or high school	Post-secondary education (e.g., teachers college)	Bachelor's degree	Master's degree or above
☐	☐	☐	☐

34. Do you have a Bachelor's degree in Science or Mathematics?

BTG34A1

Please mark only one choice.

1	2	3	4
No	Degree in Mathematics only	Degree in Science Science only	Degree in both Mathematics and Science
☐	☐	☐	☐

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35. Do you have a teaching license or certificate?
BTG35A1

1	2
No	Yes
☐	☐

36. How many years of experience do you have in teaching Mathematics or Science?
BTG36A1

1	2	3	4	5
Less than 2 years	2–4 years	5– 9 years	10–19 years	20 years or more
☐	☐	☐	☐	☐

(Language and layout errors of Addendum C were made by the original author of the questionnaire).