

The Pedagogical Value of Open Sankoré in Teaching Mapwork Skills to Grade 8 and 9 Learners in a South African Public School

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Abstract

In the field of Geography, mapwork remains a subject where teachers experience many pedagogical barriers. The research considers the benefits of using ICT to lessen pedagogical problems that teachers face with mapwork skills in a Geography classroom. This research is based on understanding the pedagogical value of a smartboard software called Open Sankoré, in order to teach mapwork skills in Grade 8 and 9 Social Science.

The research focuses on how Open Sankoré can benefit the teaching of mapwork skills not only for the Social Sciences but for FET Geography classrooms as well. The research draws on qualitative methods such as interviews and observations in one public school. Thereafter the research considers an in depth analysis of lessons and teacher interviews by drawing from frameworks such as Laurillard (2002) Conversational Framework (CF) and Innes (2009) definition of spatial competence. The CF allows for a better understanding of the value of Open Sankoré as an ICT teaching tool. Whereas Innes (2009) definition of spatial competence, assisted the research to explain the value of Open Sankoré as a geographical teaching tool. The conclusion was drawn from teacher's experiences in relation to their training and teaching sessions with Open Sankoré.

The research has highlighted that teacher's experiences, values and beliefs of mapwork as well as ICT, play a significant role in understanding the value a ICT tool brings to teacher pedagogy. Teacher training must also be considered in order to understand the value the ICT tool brings to teacher pedagogy.

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God Bless.

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Chapter 1: Introduction to the Study

1.1 Introduction

There are many difficulties that Social Science teachers face in South Africa when it comes to the teaching of mapwork concepts. Most of the problems that teachers face with mapwork have also been experienced by the researcher herself. These problems stem from the lack of teaching tools that assist teachers to convey mapwork knowledge to learners. Another problem that teachers face is that learners lack *spatial competence*, which is a skill that enables learners to interpret, analyse and read a map (Innes, 2009). The lack of spatial competence amongst South African learners results in learners performing poorly in mapwork, and as a result, developing negative attitudes towards mapwork skills, making it a challenging subject to teach.

One of the skills learners find difficult within mapwork sections is mapwork calculations. This is evident in the Department of Basic Education's (DBEs) report of (2014), which highlighted that Grade 12 learners had difficulty in answering questions that required "basic knowledge of calculations and map interpretation, and GIS" (Wilmot, 2015, p14). This sparked concern because basic mapwork skills should be mastered in Grade 8 and 9. In the experience of the researcher in Grade 8 and 9 Social Sciences, teachers tended to ignore learners' misconceptions of mapwork because of time constraints and lack of motivation. It is imperative for learners to understand the foundation of mapwork, because these misconceptions are carried into Grades 10, 11 and 12.

Innes (2012) emphasised that it is important that teachers incorporate technology within their Geography classrooms, to improve learner's spatial competence. Studies such as Medzini (2015), Cowan and Butler (2013), as well as Jackson (2000), have stated that using various digital technologies such as mobile devices and computer games in Geography classrooms, increases teacher and learner motivation in learning subject material. Jackson (2000) highlighted that the Eurogame impacted the Geography classroom positively.

Cowan and Butler (2013) and Medzini et al., (2015), have also proven that using handheld devices such as tablets and smartphones in a Geography classroom has positively impacted learners' performance and motivation to learn within a Geography classroom. It is evident within these studies, that the integration of ICT in the Geography classroom can impact the

process of teaching and learning positively.

ICT may provide a solace for teachers in overcoming the difficulties they have experienced in the teaching and learning of mapwork skills. This research will investigate whether the use of technology, particularly the Interactive Whiteboard software (IWB) Open Sankoré can assist teachers in enhancing their mapwork pedagogy, by eradicating the difficulties they experience when teaching mapwork skills to Grade 8 and 9 learners. As of January 2018, the software has undergone a name change to Open Board. At this time, the report was at its final stages of completion and therefore throughout the report, the software will be referred to as Open Sankoré (OS).

1.2 Background

Geography is known within the senior phases as Social Science. In the Curriculum Assessment Policy Statement (CAPS) Grade 8 and 9 Social Science is separated into two subjects; History and Geography. The main aim of mapwork skills in the curriculum is to develop Graphicacy skills. Graphicacy skills are the use of “maps, aerial views, globes, graphs and drawings to help them interpret and present the world” (CAPS Senior Phase, 2011, p12). To develop these skills, teachers need adequate contact time with learners.

According to the CAPS document, Social Science is allocated three hours a week, which is equivalent to the Natural Sciences. The policy states that Geography and History should be assessed every term. Some schools either split the three hours for Social Science or split the term. In the Grade 8 and 9 curricula, mapwork is only taught for five weeks in the first term and then tested in the June exams as well as the November exams. Grade 8 and 9 learners in total, only have fifteen hours of contact time of mapwork skills with their Social Science teacher. This is a large gap between the senior phases and the Further Education and Training (FET) phases, because when learners get into Grade 10 the contact time for mapwork triples for mapwork skills. It is obvious, by analysing the curriculum, that there is a lot of emphasis put on mapwork skills for Grades 10, 11 and 12 because the average contact time within these phases is twenty-four hours. This is a big jump from fifteen hours in the senior phase. It is obvious that there is not enough focus on mapwork skills within the senior phases. Due to the lack of focus on mapwork skills within the Grade 8 and 9 curricula for mapwork skills, the study takes preference in these grades.

There have been several attempts to address mapwork difficulties amongst teachers and learners in South Africa. Innes's (2009) dissertation titled *Development and evaluation of a self-instruction method for analysing spatial information* had investigated learners' mapwork difficulties by assessing how learners performed in mapwork by learning mapwork skills, through a computer game called *Maptrix*. Learners worked at their own pace and teachers acted merely as facilitators. Innes (2009) claimed that teachers did not play a central role in the study because there is a lack of adequately trained Geography teachers in South Africa to teach mapwork skills effectively. The study found that overall, *Maptrix* was identified as a useful tool to improve learner's *spatial competence*. The most interesting finding of the study however, is that even though the teacher did not play a significant role in the beginning of the study, the study found that there is a need for adequate teacher training in using *Maptrix*, for the effective implementation of the digital tool in Geography classrooms. Innes's (2009) study highlighted that teachers play a significant role in the effective learning of mapwork skills. Innes's (2009) dissertation inspired the study to focus on teachers rather than learners, to explore tools that can assist teachers in enhancing their pedagogy of mapwork skills.

Amosun (2016) as well as Okwilagwe (2002) papers also inspired the study to focus on teacher pedagogy rather than on learners. Amosun (2016) investigated the teaching of mapwork reading. Even though this is based in a Nigerian context, there were similarities in the difficulties Nigerian teachers experienced, when compared with South African teachers. The study found that teachers have poor subject knowledge of mapwork skills and that teachers have no adequate resources, as well as inadequate teacher training. The study also found that teachers have a negative attitude towards teaching mapwork skills. It was also highlighted in Okwilagwe (2002), that teachers negative attitudes towards mapwork skills affected their quality of teaching the subject. Okwilagwe (2002) also highlighted the importance of teacher programs and training of mapwork skills. Even though the education field promotes a constructivist approach to learning, the teacher still plays a significant role, and therefore the research will focus on teachers' pedagogy of mapwork skills.

1.3 The Purpose of the Study

The lack of basic mapwork skills in the Grade 8 and 9 intermediate phases has carried into the Further Education Training (FET) phase and even further into tertiary education. This is

highlighted by Larangeira and Van der Merwe (2016), where first year education geography students at the University of the Witwatersrand Education struggled with mapwork concepts that stemmed from inadequate teaching methods in high school. Out of the ninety-nine students that participated in the study, forty students passed and fifty-nine failed school mapwork examination papers. One of the sections of mapwork skills that the students failed to master was co-ordinates. This has sparked concerns because these skills should have been mastered in Grade 8 and 9. It is evident from Larangeira and Van der Merwe's (2016) study that Geography teachers also struggle with understanding mapwork concepts. This is another problem that teachers face because it becomes difficult to convey concepts to learners if the teachers themselves do not understand what they are teaching.

Due to the lack of resources, as well as inadequate teacher training, teachers feel unprepared and intimidated by the teaching of mapwork skills, and therefore do not teach it (Innes, 2009). In Wilmot (2015) there was a small-scale study that highlighted that there are "different approaches to teaching and learning in primary school classrooms, an unevenness in resources and sources of information used for teaching, and little evidence of mapwork being taught" (Wilmot, 2015, p13). It is evident that there is an urgent need for innovative teaching resources for the Senior phases in Social Science. Teacher pedagogy and how teaching tools are used to teach mapwork skills play an integral role in understanding mapwork concepts.

Most schools in South Africa teach mapwork skills from textbooks and, according to Ekiss and Trapido-Lurie (2006), in Innes (2009), this is simply not enough. Learners must be able to work with paper and digital maps, to improve their spatial orientation. Paper maps however, do not have the same value as digital maps. Due to the development of information communication technology (ICT), within the Geography field, digital maps are becoming more accessible to teachers and learners (Larangeira & Van der Merwe, 2016). Digital maps can be a useful teaching resource because teachers and learners are able to manipulate spatial data according to their learning needs.

Innes (2009) has highlighted that spatial information communication technology (ICT) can enhance teacher and learner *spatial competence*. Spatial Information technology refers to any tool that can represent different locations on a map, satellite images or photographs. According to Innes (2009) by improving spatial competence will increase teachers and learners capabilities of mapwork skills. The purpose of the study is to understand how Open Sankoré which is considered spatial ICT can improve teacher's spatial competence within their

pedagogy in the classroom.

As mentioned above Innes (2009) has stated that teachers do play a fundamental role in teaching mapwork skills. As a result of this, the study combines spatial ICT and teacher pedagogy in order to have a further understanding on how spatial ICT has impacted the teachers pedagogy in the study of teaching mapwork skills.

1.4 Research Problem

The research focus is to investigate if Open Sankoré can support and enhance teachers mapwork pedagogy. Teachers face many difficulties when it comes to the teaching of mapwork skills. The research hopes to eradicate some of these difficulties. The difficulties that teachers face with mapwork are discussed below:

1. South African Social Science teachers experience is that their own knowledge of mapwork skills is limited. As a result, teachers also lack *spatial competence* to teach mapwork skills.
2. Teachers at secondary schools are underqualified to teach mapwork skills. At the school where the study took place teachers are qualified to teach History or other subject specialization such as Economic Management Science, Consumer Studies and Life Orientation and are teaching mapwork skills to Grade 8 and 9 learners.
3. Because of the lack of knowledge and the lack of training, there has been a consensus amongst Geography teachers not only in South Africa, but around the world that there is generally a negative attitude towards teaching mapwork skills. This is evident in Innes (2009), Okwilagwe (2012), Larangeira and Van der Merwe (2016) and Amosun (2016).
4. There is also a lack of time allocated within the Social Science curriculum. In Grades 8 and 9 Social Science is split into Geography and History. Only one term in the year highlights mapwork skills.
5. Social Science teachers also face the problems of inaccessibility to maps and mapwork stationary. In government schools teachers are faced with large pupil to teacher ratios. In most cases learners will have to share maps and stationary in a mapwork lesson. Maps and stationary are costly and therefore most schools cannot afford to provide these resources to every single learner.

6. Learners experience difficulties with mapwork skills because they are unable to apply mathematical concepts to different subject such as mapwork (Okwilagwe, 2012). This could be due to the lack of exposure to practicing mapwork skills. As a result, it is difficult for teachers to scaffold mapwork calculation because learners are not able to apply this knowledge.

The study incorporates an ICT tool known as Open Sankoré this is an open source and is freely downloadable and is compatible with Android, IOS, Windows and Linux operating systems, therefore it is easily accessible to most laptop and desktop users. Open Sankoré was also chosen because it includes all the specific digital tools that are needed to teach mapwork skills such as digital rulers, erasers, protractors, pens and calculators.

Open Sankoré was particularly chosen for the study because it creates an opportunity for teachers to use maps of places that they are familiar with, as well as the learners. This access to different types of maps will enable the teacher to apply the same mapwork concepts to a different context, which may develop Grade 8 and 9 learner's *spatial competence*. For instance, there can be a Topographical map of Port Elizabeth as well as an Orthophoto map and since the software is directly linked to google maps, satellite photos are also shown of Port Elizabeth. The software makes use of multimedia because it is directly linked to Google Maps as well as the Internet. Marzano in Hewitt (2010) states that these features increase student engagement in a lesson. Teachers can quickly access lessons because there are "excellent graphics and visuals such as downloaded pictures and video clips from the Internet or Google Earth, and graphs and charts to aid in presenting information" (Hewitt, 2010, p7). This functionality is also present within Open Sankoré.

One of the main reasons Open Sankoré appealed to the research project was because it has the potential of improving the visibility of mapwork concepts within the lesson. Levy (2002) in Smith et al., (2005) stated that using interactive whiteboards in the classroom improves learner's motivation to engage in lessons due to "the strong visual and conceptual appeal of the information that is displayed" (Levy, 2002, p445). Open Sankoré has the potential to encourage teachers and learners to be more engaged with topographical and orthophoto maps during the mapwork lessons. Since the Open Sankoré may improve the visualization of maps as well as mapwork concepts it can be recognized as a visualization tool. According to Schonborn and Anderson (2005), visualization tools are of vital importance for learners understanding of content knowledge. Visualization tools can be classified as "photographs, micrographs,

pictures, diagrams, illustrations, drawings, images, analogical representations, metabolic maps, symbolic pathways, genomic representations, graphs, icons, static visuals, dynamic visuals, animated visuals, multimedia, and virtual reality environments” (Schonborn & Anderson, 2005, p94). Visualization tools assist learners in understanding abstract concepts such as, spatial difference, spatial intelligence and map literacy.

Introducing a new digital tool such as Open Sankoré into teacher’s pedagogy, due to its functionality, has the potential to alleviate some of the pressures and problems teachers may face in the Social Science class. The researcher has recognized that some of these problems are more complex, such as the lack of teachers’ subject knowledge. Just to simply implement a new tool to a teacher’s pedagogy is not going to eradicate the problem, but it may encourage teachers to feel more comfortable teaching mapwork skills, because other problems that they may have faced before are no longer present.

1.5 Research Questions

1. How can the use of Open Sankoré support teachers’ pedagogical needs to teach mapwork skills effectively in Grade 8 and 9 classrooms?
2. What are teachers’ perceptions on teaching mapwork with Open Sankoré?
3. What functionality of Open Sankoré has enhanced the teaching of mapwork in Grades 8 and 9 Social Science?

1.6 Research Objectives

The aim of the research is to understand how Open Sankoré supports teacher’s pedagogical needs to teach mapwork skills effectively in Grade 8 and 9 classrooms. Open Sankoré may provide an increase in teacher’s confidence in teaching mapwork skills because certain challenges of maps such as visibility and accessibility are eliminated. This will be analysed through three main frameworks which is *Laurillard (2002) media forms*, *Conole and Van Dyke’s (2004) taxonomy of affordances for ICTs* and through *Innes’s (2009) definition of spatial competence*. These three frameworks will be discussed in further detail in Chapter 2.

- The research will devise if Grade 8 and 9 Social Science teachers can adopt Open Sankoré into their teaching methods with ease.
- The research will also investigate the benefits and the disadvantages of using Open Sankoré as a digital tool for teaching mapwork skills.
- The use of teaching mapwork using Open Sankoré to Grade 8 and 9 learners may

provide further developments for effective tools to teach mapwork skills. The research will develop a further understanding of what Social Science teachers consider as useful tools and resources to teach mapwork skills. The research is focused on a bottom-up approach, meaning that eliminating teaching problems in Grade 8 and 9 may lead to successful results in the FET phase.

- The research provides an opportunity to investigate whether Open Sankoré has any pedagogical value towards teaching mapwork skills.

1.7 Conclusion

This chapter has discussed the motivation and reasoning behind the research. There is a clear indication of the difficulties teachers experience within the Social Science classroom. These difficulties have been written about; predominantly in Innes (2009) as well as Amosun (2002). Some of the difficulties that were mentioned in this chapter have also been experienced by the researcher herself. Social Science as a subject has also been discussed and it has been made clear that there is a need for more teaching tools to assist teachers with teaching mapwork skills. The digital tool that may provide solace for teachers is Open Sankoré.

Chapter 2: Literature Review

2.1 Introduction

This research is focused on investigating whether Open Sankoré is a beneficial digital tool in enhancing and supporting teacher pedagogy of mapwork skills. The literature is discussed in three major themes: *Difficulties teachers face with mapwork skills*, *Instruments that are used to determine Open Sankoré pedagogical value* and *Open Sankoré as a digital tool to teach mapwork skills*.

2.2 Difficulties Teachers Face in Teaching Mapwork Skills

There are many studies that explain why learners and teachers struggle with mapwork. Innes (2009), Larangeira and Van der Merwe (2016), Wilmot (2016) and Amosun (2016) have done extensive research on this matter. Innes's (2009) main focus in her research was to improve learners' understanding of mapwork skills, especially in Grades 10, 11 and 12. Not much research has been identified by the researcher that focuses on the teaching and learning of mapwork skills in Grade 8 and 9 phases therefore, there is a need within the field for this study.

To have a clear understanding of land, users must be able to interpret, analyse and read maps, therefore mapwork is an important component of Geography, which allows for the understanding of spatial area in relation to natural and artificial features on land (Innes, 2009) and Campbell (1948:2) define a map as: "*A device for storing and communicating information about the physical and social phenomenon that are distributed over the earth's surface – a data storage and retrieval system for spatial information*" (Innes, 2009, p8).

Professionals who work with maps daily, such as government planners, land surveyors and engineers use maps to make decisions about a specific area. Community members who are not able to read maps of the locations where these decisions are taking place, are at a disadvantage because they are not able to be part of the decision-making process (Innes, 2009). In developing countries, mapwork is seen as a life skill. These skills are nurtured from primary school and become more profound when taught in secondary schools (Innes, 2009).

The skill of interpreting and reading a map is a very important skill to acquire, especially in the age where more and more digital maps are being used, such as Geographical Information Systems (GIS). Digital maps are used to organize various categories of information on a certain area. In the subject of Geography, mapwork is a subject where learners perform badly. In the

DBE report of 2016 Matric learners did better in Paper 1, which is a theory paper than in paper 2, which is the mapwork paper. “Candidates generally continue to struggle with calculations and they neglect to show the different steps they have followed” (DBE, 2017, p98). There is a need for research within the teaching and learning of mapwork skills in South African schools.

Innes’s (2009) thesis investigates if a computer programme called *MapTrix Geomatica* can improve spatial competency skills within Grade 10, 11 and 12 learners in South African schools. Although Innes’s (2009) study focuses on learners, and is based on constructivism theory the research is still important to inform this research project, especially for mapwork aspects within the research. There is also a form of ICT integration within the study, which can also inform the research.

Innes (2009) has stated that there is a low level of *spatial competence* amongst teachers and learners, throughout South African schools. Innes (2009) has stated that there “appears to be little support for Geography teachers and little research attention focused on the problems of introducing a new curriculum” (p130). Innes (2009) was referring to the implementation of the National Curriculum Statement (NCS), as well as Outcomes Based Education (OBE). Although this is only stated for the NCS and OBE, the same problem still lies with the implementation of the Curriculum Assessment Policy Statement (CAPS). There are inadequate resources or teacher development programs for assisting teachers in teaching mapwork skills effectively in the classroom. As a result, Geography teachers lack *spatial competence* which negatively impacts their teaching of mapwork skills.

Innes (2009) has defined *spatial competence* as the ability to understand spatial information through the lens of three categories: maps, mind and the real world. Innes (2009) states that learners must be able to read and interpret the physical map that is in front of them. Learners must be able to study the map and create links with the real world. These connections and links are created in the learner’s mind. These connections are known as the cognitive map or schemata. These connections are created through links with prior knowledge and new knowledge in the mind. To enhance *spatial competence* amongst learners, teachers must be able to mediate knowledge from the mind to the cognitive map. The cognitive map is then used to convey knowledge into the external environment.

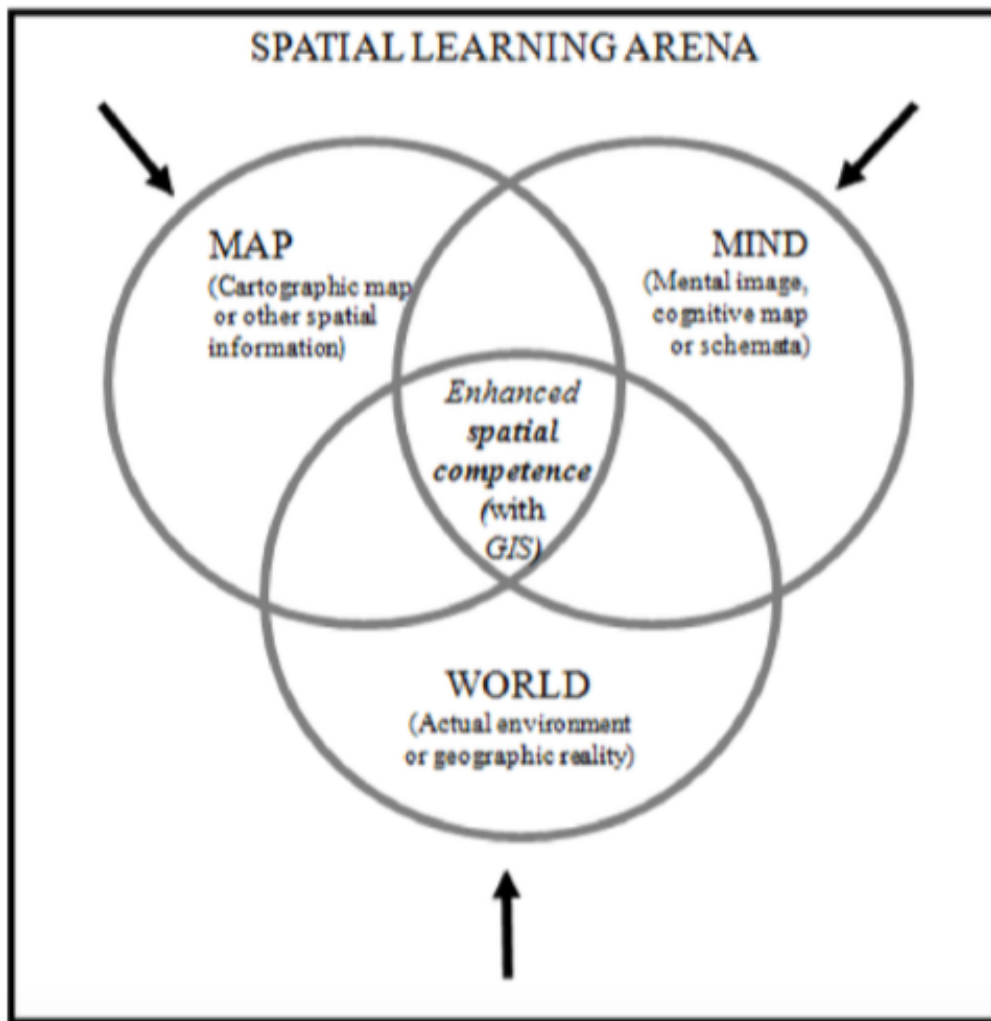


Figure 2 1: Visual representation of Innes (2009) Spatial Competence

The map

For teachers and learners to understand spatial information, a map of a specific location must be present. Learners must be able to understand that a map is a representation of reality (Innes, 2009). Teachers must use maps of places that they are familiar with to gain more confidence in content knowledge. Most teachers use Topographical and Orthophoto maps of places that do not know where it is in relation to the world. As a result, teachers cognitive spatial understanding is obscured. This is also why learners struggle to interpret the physical map because it is of an area they are unfamiliar with.

To improve *spatial competence* amongst Geography teachers extensive research must be done on the maps by teachers and departments prior to teaching them in class. In the case of learners not being familiar with the map of a place, teachers must be prepared to describe the area, for the learner to improve their familiarity of the specific location. Peterson in Innes (2009) stated

that “by bombarding the brain with more visual information to compensate for lack of prior knowledge, tunnel vision results, effectively blocking the comprehension process (Innes, 2009, p45). Teachers must be wary of how they familiarise learners with maps because this is a crucial process. If teachers use other maps to explain one map to learners, this will confuse learners even more. Teachers must take into consideration how information will be transferred from the physical map to the learner’s cognitive map, for effective understanding of mapwork concepts.

The mind

The term that describes cognitive mapping adequately, according to this study, is by Tversky (2005) in Innes (2009), which describes it as an active agent in the mind that enables individuals to judge distances and directions, to make informed deductions based on spatial information. According to Innes (2009) a cognitive map includes “direct memories of places visited, as well as information from vicarious sources such as verbal or written accounts from others, pictures from print, television or the cinema” (Innes, 2009, p41). In other words, the cognitive map refers to existing knowledge of mapwork skills within the learner’s mind. When the learner has learnt a new mapwork concept it is mediated into their cognitive map. It is important that teachers know how to mediate mapwork knowledge into the cognitive map, to enhance learner’s *spatial competence*. Teacher’s cognitive map must be well developed to scaffold mapwork concepts to learners.

For effective mapwork teaching to occur, teachers must relate to learner’s memories of specific places. For instance, if the teacher is referring to a Topographical map of Port Elizabeth, the teacher must identify specific landmarks that the learner is familiar with, such as posing the question: *Who has ever been to a beach?* Therefore, learners have a better spatial understanding of the area, even though they have never been there.

Bunch et al., (2008) in Innes (2009), has emphasized that this is an important concept to understand and master, especially in a time of technological advancement such as GIS where imagery can be manipulated from simple sets of data to complex sets of data. Through GIS the representation of the world can be altered. Most Geography teachers are not aware of cognitive mapping and do not take this into consideration, when planning mapwork lessons and therefore teachers struggle to explain mapwork concepts.

The world

To develop *spatial competence* there must be a clear understanding of the world around us. Understanding the world around us is dependent on how our cognitive maps are constructed. Even though maps and the mind were discussed separately, Innes (2009) stated that to understand the real world, both cognitive maps and cartographic maps must be used to understand the real world. Innes (2009) highlighted the use of these cognitive maps and described how cartographic maps are commonly confused. An example of this is that the most common mistake learners struggle with in mapwork skills, is converting the map measurement to a real-life distance (Innes, 2009).

There are many theories that are taken into consideration in the education field of how the individual accesses the real world. This varies from behaviourism and cognitivism to constructivism. Innes (2009) stated that for teachers and learners to access the real-world, equilibration within the individual must take place. Piaget (1964) in Innes (2009) stated that equilibration is “putting experiences into relation with one another to achieve a system which is stable, consistent and non-contradictory” (Innes, 2009, p46). Equilibration refers to where learners adapt new concepts into their pre-existing ones. In order to learn through equilibration two processes are considered, accommodation and assimilation. Accommodation is where the learners cognitive map is adjusted to understand new knowledge. Assimilation is where learners transform new knowledge to fit it into their cognitive maps. Piaget (1964) stated that organizing cognitive information through such systems is called schema. Schema are organized through assimilation and accommodation.

Piaget (1964) created four development stages that a child goes through as they experience the real world. These stages are sensory-motor, pre-operational, concrete operational and formal operational. Infants are known to be in the sensory motor phase where their spatial behaviour develops from reflex actions to co-ordinated actions (Innes, 2009). The pre-operational stage is where learners can recognize their route home and recognise landmarks (Innes, 2009). In the concrete operational stage learners are beginning to understand that space can be measured and are able to differentiate between different presentations of imagery. Once the formal operational stage is reached (which is particularly in a young adult) the learner can understand symbolism and is expected to explain, predict, analyse, synthesize and evaluate spatial information. It is ideal that Grade 8 and 9 learners should have already reached the Formal Operational Stage because then they are able to understand symbolism. This is the most

important skill to have to understand a map. Innes (2009) has stated; which was discussed earlier, that for the learner to understand a map they must understand that it is a representation of reality. As a result, for the teacher or learner to acquire *spatial competence* it is vital that they should have already reached the Formal Operational Stage.

Naish (1982) listed mathematical concepts that would assist teachers in acquiring the formal operational stage within learners. These concepts are “weight, quantity, volume and number, inclusion (classification of objects according to similarities and differences), seriation (arrange according to size, weight) and reversibility (change of perspective or scale of representation does not change reality)” (Innes, 2009, p51). In most cases these concepts have not been taught because teachers are intimidated by content knowledge, and therefore do not teach them. Castner (2002) in Innes (2009), highlighted that teachers do not know the work themselves or do not want to turn learners off mathematical concepts. In the higher grades teachers assume that these spatial skills have been taught and therefore neglect them and move on to more advanced work that is too complicated for learners (Innes, 2009). It is important that teachers are aware of these stages to track student’s degree of *spatial competence* (as well as their own), to pitch lessons at an appropriate level.

Teaching of mapwork skills

Traditionally mapwork was taught with hard copy Topographical and Orthophoto maps. The first map that is introduced to Grade 8 and 9 learners is a Topographical map. This is a representation of reality by using conventional symbols. The second type of map is the Orthophoto, which is a black and white photograph taken of a specific place, containing added topographical information. Geographers use these maps to gather a visual understanding of a location. Each student is required to have a map which they can use to practice mapwork calculations and map interpretation. In most cases public schools do not have enough maps to provide to each learner (Innes, 2009). Normally the desks are too small for these maps, which makes it difficult for learners to measure accurately. Learners cannot clearly see what the teacher is referring to, especially learners at the back of the classroom. Learners do not bring the required mapwork stationary to class, which makes teaching of mapwork skills challenging.

Larangeira and Van der Merwe’s (2016) research informed the study of how secondary mapwork education impacts tertiary mapwork education in the first year of a Bachelor of Education degree. Larangeira and Van der Merwe (2016) also highlighted that there is a lack of research that studies mapwork pedagogy; and further research must be done to gain a better

understanding of teachers' and learners' needs when it comes to mapwork skills. The research was found to be useful for the study because it highlighted the difficulties that students faced during mapwork skills at a tertiary level. The research also highlighted the inefficiencies within teaching pedagogies, towards mapwork skills in secondary schools. The main concern from this study is that skills that should be mastered in Grade 8 and 9, such as mapwork calculations are still a major problem right up to university level.

Larangeira & Van der Merwe's (2016) study highlighted that students battled with mapwork calculations, as well as cross-sections. The main reasons learners battled with these sections is that there is a lack of effective teacher pedagogy in secondary schools. "Students who had trouble with map literacy were not taught mapwork skills on a regular basis at school level, and the methodology used was different from that of the lecturers at university level" (Larangeira & Van der Merwe, 2016, p134). Okwilagwe's (2012) study of how Nigerian Geography teachers in secondary school's attitudes towards mapwork affected learner's knowledge, found that there were inadequate teaching practices. The study highlighted that Topographical maps are not taught to learners and are hidden away. "Students have no knowledge of, nor have they ever seen Topographical maps in their entire school life" (Okwilagwe, 2012, p67). Okwilagwe (2012) stated that teacher qualifications and experience within Geography also affected teacher's attitudes. As mentioned earlier teachers that teach Grade 8 and 9 Social Science are not qualified to do so, and this results in ineffective teaching practices. This study is beneficial because it highlights the fact that teacher's perception of mapwork does affect their teaching abilities. Although this is not the focus of this study, it does highlight important implications of teaching mapwork skills.

There is an outcry and a demand from Geography teachers and learners to improve the teaching and learning of mapwork skills. This was also emphasised in Anikweze (2002) in Okwilagwe (2012), that stated that teachers are unable to mapwork content knowledge effectively. "The influence of the teacher on the personal, social and productive lives of students is usually the product of the professional training which was received" (Okwilagwe, 2012, p68). Okwilagwe (2012) highlighted that Geography departments should focus on pre-service and in-service teacher training for effective teaching to occur. Larangeira and Van der Merwe (2016) also suggested that bridging courses should be offered to Geography education students; as well as constant integration of mapwork skills throughout the Bachelor of Education degree, within the Geography course.

2.3 The Use of Theoretical Frameworks to Determine ICT Pedagogical Value

This literature will first analyse the Vygotskian concept of mediation, because by using digital tools in classrooms, teachers are aiding the learning process; consequently, digital tools are acting as mediators for learning. Secondly, the literature will evaluate Laurillard's (2002) conversational framework, which highlighted the significant teaching and learning processes that contribute to a successful teaching and learning environment, using ICTs. Laurillard (2002) stated that a digital tool that can support these teaching and learning processes would contribute positively to teaching and learning. Thirdly, the literature will discuss Conole and Van Dyke's (2004) taxonomy of ICT affordances, because the framework outlines certain characteristics that must be present in any digital tool that is used in an educational environment.

The use of digital tools to enhance mediation

Vygotsky's constructivist theory is popular, due to its consideration of social presence and cultural experiences of an individual which affects the way knowledge is acquired (Kozulin, 2003). Every culture and society are different; there are different values and beliefs. Individuals interpret the world through what Vygotsky calls psychological tools. Psychological tools are symbolic objects that assist the individual in acquiring their own psychological functions such as memory, attitude and web of beliefs. Every society or culture has their own set of psychological tools and thereby, individuals interpret knowledge differently (Kozulin, 2003). Teachers are confronted daily with different sets of societies and cultures in a classroom. There are different ethnic groups as well as different religions. As a result, learners interpret and acquire knowledge differently, based on their psychological tools.

The concept of mediation "emphasizes the role played by human and symbolic intermediaries placed between the individual learner and the material to be learned" (Kozulin, 2003, p3). According to Vygotsky the development of higher-order thinking processes in a child are dependent on the mediating agents between the child's mind and the external environment (Kozulin, 2003). Mediating agents provide guidance in acquiring new knowledge. Gardiner (2006) refers to these mediating agents as teachers, parents, peers or tasks. These agents transfer knowledge through language. According to Vygotsky teachers must use language to communicate important school knowledge. This is known as dialogic teaching.

Vygotsky theorists state when learners do not understand content knowledge it is not because of "poor presentation of content materials but from the lack of necessary cognitive strategies

and metacognitive skills” (Kozulin, 2003, p16). This addresses the problem of South African teachers not having the necessary knowledge or resources to teach mapwork skills effectively, and therefore it results in learners’ misunderstanding of mapwork concepts.

Mediation can also influence Innes’s (2009) definition of *spatial competence*. Even though Innes (2009) explained that the world must be linked to the cartographic map and cognitive map through the Piaget cognitive theory of equilibrium, it can also be linked through mediation. A digital tool such as Open Sankoré can link the cartographic map to the learner’s cognitive map, by sound visual representation of mapwork concepts.

The way that ICTs are used in the classroom can also be classified as a mediating agent. In the research teachers would guide learners in how to do a specific mapwork calculation, by showing learners the method using Open Sankoré. The understanding of Vygotsky’s mediation process is important within the study, because it is important to understand the effect that social agents such as ICT tools has on learning. Grandin (2006) also highlighted that mediating agents play an important role in how an individual acquires knowledge. An example in Grandin (2006) describes a learner who has “access to a computer on the Internet” which would alter the rate and way in which a student would acquire information over a student in a primitive society, where there is no electricity” (Grandin, 2002, p24). This highlights how ICTs can change the teaching and learning process. The teacher is a liaison for the transferral of knowledge, even in a case of the use of digital tools. The teacher is responsible for guiding learners through learning material, even if an ICT is being used.

For teachers to guide learner’s effectivity with ICT, the teacher must have developed Technological Pedagogical and Content Knowledge (TPACK). Koehler and Mishra’s (2009) framework of TPACK considers three knowledge bases which are teacher pedagogy, teachers content knowledge and teachers knowledge of technology. TPACK also considered the relationships between the knowledge bases, for successful teaching and learning to occur. This is loosely based on Shulman’s theory of Pedagogical Content Knowledge (PCK). Koehler and Mishra (2009) stated that the integration of ICT is a complex process and therefore the teacher must have an in-depth understanding of all three knowledge bases and their relation to one another. Koehler and Mishra (2009) also highlighted that teacher training programmes do not consider teacher diversity. The individual training sessions that were offered were designed to attend to each individual teacher’s needs, such as difficulties and concerns with the software.

Vygotsky emphasized that “cognition is always socially mediated or influenced by others in

social interaction. However, “individuals must internalise cognition” (Samaras, 2002, p80). Vygotsky also highlighted that learners must have the motivation to engage and internalise knowledge. The individual is responsible for his/her own engagement in learning. In schools, learners are exposed to complex knowledge systems and teachers are responsible for conveying these complex knowledge systems to learners. Teacher pedagogy plays an integral role in the rate of engagement in a lesson. Teachers should assist learners to be constantly engaged and motivated to learn. Chandler and Munch (2016) stated that Geography pedagogy within the United States consisted of lower-order thinking practices such as teaching learners geographical facts. Barton and Levstik (2003); Cuban (1991); Levstik (2008); Ross (2000) admitted that there is a low standard of pedagogy within social studies classes (Chandler & Munch, 2016). This is not enough to keep learners engaged in Geography lessons, especially when it comes to mapwork.

To address these pedagogical issues within Geography in the United States, the National Geographic Society, the Association of American Geographers, the American Geographical Society, and the National Council for Geographic Education created teacher guidelines called a “*Road Map for 21st Century Geographic Education*” (Chandler & Munch, 2016). In the *Road Map for 21st Century Geographic Education*, the Road Map stated what teachers should take into consideration within their lessons to encourage effective geographic practice:

1. Posing geographic questions;
2. Acquiring geographic information;
3. Organising geographic information;
4. Analysing geographic information;
5. Answering questions and designing solutions; and
6. Communicating geographic information.

In addition to the *Road Map for 21st Century Geographic Education*, Chandler and Munch (2016) suggested that to improve Geography teacher pedagogy, teachers had to incorporate Authentic Intellectual Work (AIW). AIW refers to the “organized, purposeful application of knowledge in a meaningful way” (for jobs and daily problem solving) (Chandler & Munch, 2016, p3). Teachers who use AIW in their pedagogy encourage learners to apply geographic knowledge to real world issues and ideas and thereby higher order thinking is developed; comprising tasks such as organizing, interpreting, evaluating, synthesizing and problem

solving (Chandler & Munch, 2016). Teachers who use AIW in their pedagogy can assist learners in understanding “the philosophical foundations of Geography as well as how geographic knowledge is created, used, and represented” (Chandler & Munch, 2016, p4). To utilize AIW in teacher pedagogy four factors must be taken into consideration: Construction of knowledge, disciplined inquiry, value beyond school and elaborated communication.

Construction of knowledge

Chandler and Munch (2016) referred to the construction of knowledge as learners physically engaging with geographical concepts. Learners are acting as geographical scientists, investigating concepts within the real world. The use of Open Sankoré within the classroom would allow learners to create their own maps, according to a scale based on community problems. For example, the teacher can set up an activity about drought and learners would have to create their own Topographical map, indicating where water resources are, within their own community. Open Sankoré allows teachers and learners to create their own maps where they can insert relevant pictures, shapes and colours, that could represent reality more accurately than when a map is being hand-drawn. The delete and insert functions also allow teachers and learners to delete something they do not want, as opposed to taking a brand-new piece of paper and starting all over again.

Disciplined inquiry

This category involves three factors which King, Newmann, and Carmichael (2009) in Chandler and Munch (2016) stated, the first being *the use of a prior knowledge base*, the second; *to strive for in-depth understanding rather than superficial awareness* and the third being to develop and express their ideas and findings through *elaborated communication*.

It is a general rule within teacher pedagogy within all disciplines, that learners understand new concepts better when teachers link new concepts to prior knowledge. In the Geography discipline students have had many encounters with geographical concepts within the real world, and therefore it is easier for teachers to relate new concepts to learner’s prior knowledge (Chandler & Munch, 2016). This is also related to *spatial competence*, because the cognitive map within the mind comprises pre-existing knowledge and it is the teacher’s responsibility to incorporate new knowledge into the cognitive map.

It is important not to assume that learners have been exposed to geographical concepts within Grades 8 and 9. This is because the teacher does not know what learners were exposed to in

their primary education. This is where Open Sankoré comes in handy. Even if learners have not been exposed to geographical concepts, Open Sankoré allows teachers to relate back to these concepts, because Open Sankoré is directly linked to the internet. Teachers can access images of prior knowledge, such as rivers and mountains on the software. Open Sankoré is also directly linked to Google maps, and therefore geographical concepts are easily accessible within the software.

To strive for in-depth understanding amongst Geography learners Alleman, (2010) stated that teachers should work towards learners' understanding of "how Geography can be used as a lens for understanding the world" (Chandler & Munch, 2016, p4). Learners must understand the geographical problems within the discipline and link them to their own community. This is also linked to Innes (2009). In order to improve learner's *spatial competence*, the physical map must be related to the real world. The use of Open Sankoré can assist teachers in relating geographical knowledge to the real world, because it is linked to the Internet, and therefore teachers can show learners a geographical concept that is related to the real world. For example, the teacher can show learners a Topographical map (which is a representation of reality) of a specific area, and then show the exact area via a satellite within Google maps, on the software (real image within the real world). In this way, the real world is easily accessible within the software.

"Elaborated communication speaks to the ways in which students use the language that experts within a given field use, in their day-to-day work" (Chandler & Munch, 2016, p4). This also links to Vygotsky's term of mediation. Language plays a very important role in the transferral of knowledge from teacher to learner, as well as in how learners understand knowledge. "The language used to teach geography is particularly important, especially when dealing with spatial concepts, techniques and skills" (Innes, 2012, p102). If teachers use the language that geography experts use, this will be incorporated within the learner's cognitive map. Once learners have an in-depth understanding of content knowledge, learners can synthesise concepts and are able to communicate with the use of geographical language.

Open Sankoré does not have a direct effect on the language that learners use. The researcher considers Open Sankoré as a mediating tool, which provides learners with a sound visual representation of geographical concepts; and therefore learners can understand geographical concepts better. Learners are also able to use geographical language appropriately. Through the researcher's experience within the classroom, it was seen that many learners confuse a

distance question with a co-ordinate question. Open Sankoré can assist learners in understanding the difference between distance and co-ordinates, due to the visual representation of maps that it offers.

Value beyond school

Value beyond the classroom refers to knowledge that expands beyond school knowledge. School knowledge only focuses on the competence of the learners of school's knowledge. School knowledge should focus on fostering active environments and challenging learners (Chandler & Munch, 2010). Open Sankoré can assist teachers in creating these environments, by allowing learners to use the software to create their own mapwork activities or create their own map, based on a geographical problem within their community.

Chandler and Munch (2010) have created a table that assists teachers in linking AIW practices with the *Road Map for 21st Century Geographic Education* practices, to assist in improving Geographic pedagogy amongst teachers.

Table 2.1: Relationship between AIW and Road map for 21st century education: Six Geographic classroom practices to improve teacher's geographic pedagogy

Authentic Intellectual Work	<i>Road Map for 21st Century Geographic Education: Six Geographic classroom practices</i>
Construction of knowledge	1. Posing geographic questions 2. Acquiring geographic information
Disciplined inquiry	3. Organizing geographic information 4. Analysing geographic information 5. Answering questions/designing solutions 6. Communicating geographic information
Elaborated communication	
Value beyond school	

The first column represents activities that geography teachers should consider within their pedagogy, to enhance learning. The second column links the six classroom practices within the 21st century Road Map to AIW. The use of effective AIW in the teacher's pedagogy is based on the evidence provided within the second column, which is classroom practices. This also gives teachers a guideline on how to effectively implement AIW in their pedagogy. The second column guides teachers on what classroom practices they should be implementing to encourage AIW. For example, if a teacher wants to focus on the construction of knowledge within a geographic section, the teacher should encourage learners to pose geographic and acquire geographic information. Table 2.1 can assist teachers in developing *spatial*

competence within learners. The link between the cartographic map and cognitive maps can be communicated through the AIW pedagogy.

Conversational framework

For a clear understanding of Laurillard's (2002) conversational framework, the role of teachers must be understood. Laurillard (2002) defines the role of the teacher as a mediator of knowledge. Teachers must be able to construct environments where not only learning of the world occurs, but the descriptions of the world as well. Learners access the world, and descriptions of the world differently. When learners access the world, it is more direct and when learners access explanations of the world, this must be mediated by teachers. Teachers mediate descriptions of the world through symbolic representation.

For effective mediation to occur between knowledge and learners, Laurillard (2002) described four learning processes involving the teacher and learner. The first learning process is the discursive process. This is described as a discussion between teacher and learner, where learning objectives are agreed upon. The second is the adaptive process where teachers and learners will adapt their actions according to existing concepts. Teachers can adapt their constructed environment. The third is the interactive process where teachers create a supported constructive environment, where learners are linked to the world. Learners can integrate new conceptions with already existing ones. The teacher's role is to adapt the learning constructed environment to the adapted learning objectives. The fourth is the reflection process, where teachers and learners reflect on learners' performance. The teacher supports the learner by revising concepts and catering to learners' learning needs. The conversational framework is important to this study, because it will be able to evaluate if Open Sankoré has supported the teaching and learning processes of the conversational framework, and therefore the research will be able to construct an informed argument of the pedagogical value of Open Sankoré in teaching mapwork skills to Grade 8 and 9 learners.

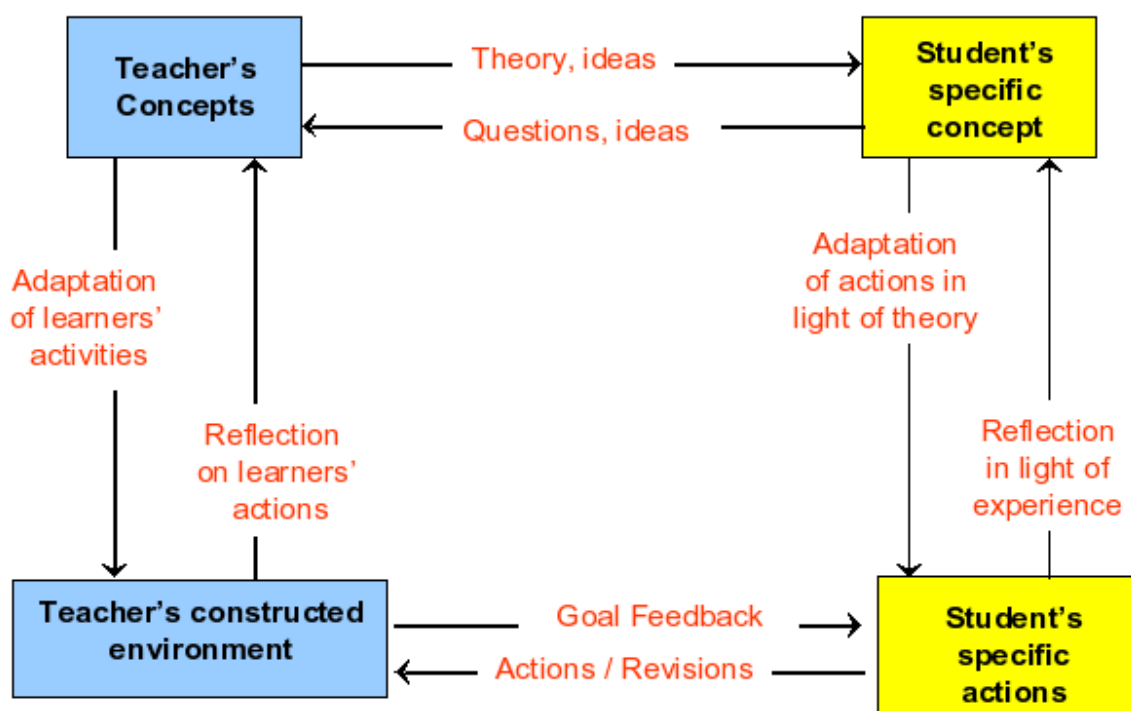


Figure 2.2: Diagram representation of Laurillard's Conversational Framework

Forms of media

According to Laurillard (2002) for an ICT tool to be of pedagogical value, the ICT tool must support the above teaching and learning processes within the learning environment. Laurillard (2002) argues that there is not only one type of medium where the conversational framework can be achieved. Media however has had the most effective results. Ndlovu (2015) emphasised that Laurillard's (2002) term of media refers to non-digital and digital resources.

Romiszowski (1998: 8) defines media in Laurillard (2002: 82): *As carrier of messages from some transmitting source (which may be a human being or an inanimate object) to the receiver of the message which in our case is the learner.*

According to this definition the transmission of messages can be transferred in many ways (Ndlovu, 2015). The effectiveness of how the message is transferred to learners is totally dependent on what and how the tools and resources are being used in the learning environment. Laurillard has developed media forms that integrated the process of learning with ICT. These media forms are not directly linked to the learning phases, but in some way or the other the media form does support these learning processes. Laurillard (2002) has classified the different types of media that are used to assist with enhancing the teaching and learning process.

There are four types of media that Laurillard (2002) has explained; which include Narrative media, Interactive media, Communicative media, Adaptive media and Productive media. These forms of media are closely related to the conversational framework. This framework will be used to inform the study, if Open Sankoré encourages the learning processes. If this is so, the tool will be considered as an effective digital teaching tool.

Narrative Media

Narrative forms of media are non-interactive and are merely there to present theory, ideas and concepts to learners. Interactive forms of media resources assist and encourage learner participation.

Interactive media

Interactive media is categorized by Laurillard (2002) as the way users can navigate and choose content at will, which enables the media to be interactive. An example of this type of media is hypermedia (Ndlovu 2015).

Communicative media

Communicative media is categorized as the way users can form discussions about content knowledge. Laurillard (2002) has stated that examples of this type of media would be video-conferencing and student collaboration. This type of media encourages the interaction process in the conversational framework.

Adaptive media

Adaptive forms of media encourage users to adjust their actions, as new knowledge is interpreted. “The user is able to receive intrinsic feedback that he or she can use, to modify learning” (Ndlovu, 2015, p32). The type of media that is used can give almost immediate and meaningful feedback to learners. This type of media encourages adoption within the adaptive learning process. Examples of this media are simulations, educational games and applications as well as virtual environments (Laurillard, 2002).

Productive media

Productive media comprises types of media that enables learners to express their understanding of knowledge and concepts by producing something with the ICT. Learners act independently, meaning that there is no form of mediation from teachers. Learners can apply their own

knowledge and skills to new concepts and are able to solve problems (Ndlovu, 2015). Examples of this type of media are micro worlds, PowerPoint and modelling (Laurillard, 2002).

The different types of media that Laurillard (2002) as described are of vital importance to the study, because Open Sankoré can be classified as one of the media types as the study progresses. This will give a clear indication of what level of Conversational Framework Open Sankoré is supporting. This will give insight to the pedagogical value of the programme.

Taxonomy of Affordances

To have a sound investigation of Open Sankoré pedagogical value, along with Laurillard's (2002) Conversational Framework Conole and Dyke's (2004) taxonomy of ICT affordances will also be used within the study. To have a clear understanding of the taxonomy of ICT affordances, the term affordance must be defined.

Solomon and Gibson (1993: 51) have defined affordance as: *"Affordance" refers to the perceived and actual properties of a thing, primarily those functional properties that determine just how the thing could possibly be used.*

Solomon and Gibson (1993) found the term to be an important one within educational technology, because affordances within digital resources affect the user's accessibility. It is important that the affordances of a digital tool are highlighted, in order to understand the effectiveness of a digital tool regarding teaching and learning. There are ten main themes within taxonomy namely: Accessibility, Speed of change, Diversity, Communication and collaboration, Reflection, Multimodal and nonlinear, Risk, Fragility and uncertainty, Immediacy, Monopolisation and surveillance. According to Ndlovu (2015) the following affordance themes were closely related to Laurillard's (2002) media forms: Multimodal and non-linear, Immediacy, Collaboration, Diversity and Reflection.

Multimodal and non-linear

Using digital resources such as the Internet and the use of hypertext, users learn through many different pathways. ICT enables learning to be Multimodal. Multimodality refers to non-linear learning pathways and learners "adopt more individualized strategies and pathways" (Conole & Van Dyke, 2004, p119). Multimodality refers to the narrative media forms which are focused on presenting concepts (Ndlovu, 2015).

Immediacy

The use of ICT enables teachers and learners to get immediate feedback; “users being increasingly required to respond almost immediately to requests” (Conole & van Dyke, 2004, p120). Feedback plays a very important role in the Conversational Framework, especially in the adaptive and interactive learning process. Teachers and learners are dependent on each other’s feedback, to shape the teaching and learning environment.

Collaborative

Collaboration using ICTs offers the potential for an enriched learning environment through new forms of communication, especially over long distances (Conole & van Dyke, 2004). This can be done through “new forms of online communities and new means of communicating and sharing information, from signing up to particular mailing lists through to involvement in specialized discussion forums and chat rooms” (Conole & van Dyke, 2004, p117). Laurillard (2002) also emphasised the importance of collaboration for the learning process and this can be achieved by using different forms of media. Laurillard (2002) highlighted that in a group setting, learners must develop their own ideas and explanations and expose them to the group. Group members analyse and interpret the information and can make changes. Learners are given an opportunity in this setting to think critically about ideas and concepts and make a valuable contribution. The affordance of collaboration is closely linked to the interaction and reflection phase of the conversational framework.

Diversity

The use of ICT exposes learners to many different experiences of the learning process; therefore the learners learning experience is extended to much more than just the classroom (Conole & van Dyke, 2004). Different perspectives of ideas, theories and concepts are shared with learners. Learners can incorporate these concepts with already existing ones. The concern is that “there may be disjuncture between the mediated ‘reported’ experience and the reality of lived experience” (Conole & van Dyke, 2004, p117). Learners may not be able to describe the differences between the real experience and the virtual experience of concepts. For the affordance to be of any educational value “the development and establishment of conceptual understanding should be the goal for engaging this affordance” (Ndlovu, 2015, p35). According to Ndlovu (2015) the technological tool that is being used must encourage learners to have a sound conceptual understanding of the content knowledge.

Reflection

The use of ICT “presents new opportunities for knowledge claims, to be considered and subjected to the critical gaze of much wider and more diverse communities of practice” (Conole & van Dyke, 2004, p118). The affordance enables discussions over a long period of time which encourages critical thinking and reflection. Through forms of media learners can formulate and express their ideas and views with one another through ICTs (Ndlovu, 2015).

The Conole and van Dyke (2004) taxonomy will be used in this study because it will inform the understanding of the pedagogical value of Open Sankoré in teaching mapwork skills. The taxonomy is useful to the study because it will categorize Open Sankoré affordances. This will give the research a clear understanding of Open Sankoré functionality as an education tool to teach mapwork skills. The taxonomy is important to the study because it outlines the advantages and disadvantages of using Open Sankoré as a digital tool, in teaching mapwork skills (Conole & van Dyke, 2004). Also, it will give rise to further development and refinements of the digital tool regarding the teaching of mapwork skills (Conole & van Dyke, 2004).

Vygotsky’s theory of mediation has highlighted that student’s motivation and engagement is important for the learning process. Laurillard (2002) has also emphasised that student engagement is an important factor in producing an effective learning process. The teacher plays a very important role in assisting learners with engaging in school knowledge. Hewitt (2006) has stated that “finding tools that students can use to access their personal areas of interest will ensure a level of engagement and motivation” (Hewitt, 2006, p1). This often falls on the teacher as mediators of knowledge, to find tools that learners respond to in their classrooms. ICTs can serve as useful mediating tools in conveying knowledge to learners.

2.4 The Effect of Teacher Beliefs and Perceptions in the use of Digital Tools

Every individual has a set of beliefs which are linked to other beliefs. These are known as core beliefs (Ertmer et al., 2010). The core beliefs interlink and form belief systems within the individual. (Ertmer et al., 2010). Hermans (2008) in Ertmer et al., (2010) states that belief systems “consist of an eclectic mix of rules of thumb, generalizations, opinions, values, and expectations, grouped in a structured way” (Ertmer et al, 2010, p262). When a new digital tool is incorporated into a teacher’s pedagogy it is conceptualized through the teacher’s belief systems; therefore, it is very difficult to change belief system because of their complexities.

For the effective incorporation of a digital tool in teacher pedagogy, teacher beliefs values and perceptions must be considered. According to Hughes (2005), Kanaya (2005), Frank (2003) in Ertmer (2010) et al., for teachers to incorporate a new approach in their existing knowledge structures, the uses must align with current beliefs (Ertmer, 2010, p263). If a new tool such as Open Sankoré is adapted effectively into teacher's pedagogy it must be in line with the teacher's belief systems.

Many studies have emphasised that teacher's belief systems influence the way technology is used within their pedagogy. Haney, Lumpe, Czerniak, and Egan's (2002) study found that the more behaviourist teacher's belief systems were, the less effective the use of technology within their pedagogy would be. The more constructivist teacher's belief systems were, there would be more effective use of technology within their pedagogy. A similar study was conducted by Niederhauser and Stoddard (1994) in Baylor (2002), where teachers who had more of a constructivist belief system used technology more effectively for the learning process. The trend seems to be that the more constructivist a teacher's belief systems are the more likely it is that the teacher will use technology effectively in the classroom.

In addition to core belief systems there is another factor that must be taken into consideration namely values. According to Anderson and Maninger (2007) in Ertmer et al., (2010), values are defined as "the perceived importance of particular goals and choices" (Ertmer et al., 2010, p263). Teachers make judgements of digital tools that are based on how a digital tool can achieve their educational goals. The more value the teacher places on a digital tool the greater is the likelihood they will use it. This is also emphasised by Baylor et al., (2002) that teachers must understand the relevance in using technology in their pedagogy for effective use. Therefore, digital tools should be in line with the curriculum, as well as the with teacher's educational goals (Baylor, 2002).

The teachers overall experience with technology plays a very important role in formulating their belief systems and values. Belief and values are manifested into teacher's attitudes towards technology. Rogers (1995) in Zhao et al., (2003) states "that teachers' attitudes towards, and expertise with, technology are often key factors associated with their uses of technology" (Zhao et al., 2003, p809). Mueller et al., (2008) emphasizes that positive experiences with technology in a classroom context, will build teachers' belief systems as well as their confidence in using technology as a learning tool. If teachers can see that Open Sankoré does assist them with difficulties they have with teaching mapwork skills, this may have a

positive impact on their belief systems. If teachers find the software hard to work with and they do not see any benefits of Open Sankoré within their pedagogy, they will have a negative attitude towards integrating the software into their pedagogy.

2.5 Pedagogical Considerations of using Technology in the Classroom

To incorporate digital tools successfully in the classroom there are pedagogical factors that must be taken into consideration, along with teacher perceptions. Baylor (2002) states that “technology will not be used unless faculty members have the skills, knowledge, and attitudes necessary to infuse it into the curriculum” (Baylor, 2002, p4). Teachers may have extensive knowledge of using a digital tool but there are more factors that must be taken into consideration when the digital tool is used for teaching and learning.

Novice teachers who use technology in their classrooms use technology as the focus point in their lessons and do not consider their educational goals for using the specific ICT. “Teachers focus on learning about computers while others focus on learning with computers” (Baylor, 2002, p4). If teachers focus on basic skills of using the technology in their lesson, higher order thinking skills are not developed during the lesson. The importance of technology within the classroom is in how the digital tool is being used to facilitate learning and not the straightforward usage of the ICT. Technology should be viewed as a tool that can enhance teaching and learning and not replace it. Open Sankoré is seen within the research as a digital tool that might simply enhance the teaching and learning of mapwork skills. Teachers must consider learners needs and curriculum goals, as well as learning objectives, to incorporate technology effectively in their classrooms.

Benefits of using IWB software in the classroom

There is an abundance of studies that have analysed the pedagogical value of IWBs within classrooms. This research is not exactly focused on IWBs, but rather on the functionality of a IWB software, which is Open Sankoré. Since Open Sankoré software has been used as an IWB, its benefits to teaching and learning has been shown to be very similar to those of IWB. The most predominant research of IWB is from Higgins and Wall (2005). They have done a significant amount of research pertaining to IWB in primary schools in the United Kingdom. Slay et al., (2008) conducted a study within a South African context of how the role out of E-Beam technology has benefited and disadvantaged teachers and learners. The work is projected on a whiteboard and teachers can write on the whiteboard with an E-pen and access different resources and material through the E-beam software. This study is of utmost importance for

this research because it informs the research on teacher's attitudes towards IWB as well as informing the study about the implications of teaching with IWB in a South African context.

Beeland (2002) emphasised that interactive whiteboards (IWB) can engage learners in many ways. The first is visual learning, visual learning is important for the learning process because it can further learners' understanding of abstract concepts.

This is also emphasized in Hewitt's (2006) study which stated that IWBs can present content knowledge in a visually interesting way, which kept learners engaged. In Slay et al., (2008) stated that South African learners found that the use of visibility of content knowledge had improved. Smith and Blankinship (2000) highlighted that visual learning could be utilized to challenge students to think on levels that required higher order thinking skills. It was also emphasized by Levy et al., (2002 & 2006) that students are motivated to answer questions in class due to the "strong visual and conceptual appeal" (Smith et al., 2006, p445) that IWB has to offer. The way visuals are used on the interactive whiteboard can encourage learners' critical thinking. This was also emphasised by Schonborn and Anderson (2005), who showed that it is necessary for a biochemist to have visual literacy skills, because biochemistry is taught through visual learning. Learners can understand microscopic features of the body in terms of diagrams, models or pictures. One of the many problems that teachers face when teaching mapwork skills is that learners are not able to visualize what the teacher is referring to on the map; and therefore, a lot of time is wasted on showing individual learners which area of the map the teacher is referring to. Using Open Sankoré, the map is presented more clearly and teachers can clearly mediate mapwork concepts.

IWB enables teachers to access different types of multimedia such as PowerPoint, as well as manipulate and adapt multimedia to content knowledge. Slay et al., (2008) indicated that the use of E- beam technology allowed teachers to access many different resources whilst teaching. Levy (2002) in Slay (2008), indicated that access to different multimedia makes content knowledge more tangible and easier to understand. Smith et al., (2005) also indicated the variety of resources that are accessible to teachers, which leads to a better understanding of what they are talking about.

Hewitt (2006) highlighted that, due to the versatility and flexibility of using different multimedia and resources, teachers can adapt lessons to the pace and interests of a class. Hewitt (2006), Slay et al., (2008) and Smith et al., (2005) suggested that, due to the accessibility to different resources and multimedia, which leads to a better understanding of content

knowledge; the pace of lessons is increased. Open Sankoré offers teachers the functionality of presenting different types of maps on the same program. Open Sankoré has a direct link to google maps. Therefore the map is seen as a Topographical map as well as a satellite image.

Slay et al., (2008) mentioned that teachers felt that there was more flow to lessons and that they had more control of class discipline, since they had a full view of the class by standing in front and teaching. Smith et al., (2005) mentioned that teachers are positioned in an authoritative position in front of the classroom, where they feel most comfortable. In contrast, Hewitt (2006) stated that when using IWB, the teacher is not limited to the front of the class and can monitor students' understanding of content knowledge, by walking around the classroom. Open Sankoré can be used in either way. This is dependent on what the teacher's educational goals are. The functionalities of Open Sankoré allows the teacher to be in front of the class, as well as being more interactive and collaborative.

Hewitt (2006) suggested that allowing learners to use the IWB allows the teacher to assess learners' understanding of content knowledge and allows learners to explore knowledge themselves. This results in learner-centred, rather than teacher centred lessons. This also encourages the collaboration and participation of learners that do not normally engage in lessons. This may encourage these learners due to the use of technology in the classroom, which relates to learner's because they were born in a technological age. Slay et al., (2008) stated that learners are motivated because education is "keeping up with the times." Levy (2002) in Slay et al., (2008) acknowledged that as the technology is used increasingly in the classroom, the novelty will wear-off. Slay et al., (2008) however, stated that if the E-beam's full potential and functionality is used always, learners will constantly be engaged and motivated. This is the same as with Open Sankoré. If teachers use the software to its full potential to teach mapwork skills, learners will never feel demotivated because knowledge is mediated clearly.

Beeland (2002) found that the software that was embedded in the interactive whiteboards allowed for student engagement. "The accompanying software programs and the level of engagement built into the lessons may have contributed to the positive effect of whiteboard use" (Beeland, 2002). These functionalities referred to saving lessons and presentations of specific lessons, which can lead to collaboration in subject departments as well as across subjects. Open Sankoré does not have a save option, and therefore presentations are always saved onto the program, therefore teachers are able to create mapwork resources without ever losing them.

Open Sankoré has the potential to offer some solutions to pedagogical difficulties facing teachers. For instance, any Topographical maps or Orthophoto maps are easily accessible when they are loaded onto the software. Digital stationary is provided on the software. Thereby teachers can show learners how to use mapwork stationary, even though it is not readily available to the learners. The software has the potential to improve visibility of the map for learners, making it easier to teach. This was emphasised by Winzenried (2010) who used smartboard software whereby visual representation of concepts was improved. This is also highlighted in Schonborn (2005) where visual representation played an important role in biochemistry students' understanding of structures of the body such as neurons and DNA. The software also enabled the teacher to create videos of calculations on a map, which can be shown to learners as a step-by-step process.

Teaching with Open Sankoré may increase the accessibility of maps, as well as increase learner's visibility of the map. It may also make learners more motivated to bring their required stationary, because maps are more visible and lessons are more interactive. This is informed by Smith et al.'s (2006) paper on the impact of IWB on teacher–pupil interaction in the National Literacy and Numeracy Strategies, which stated that IWBs “motivate pupils because of its capacity for quality presentation, incorporating large visual images”p455. Teaching with Open Sankoré may also make learners more motivated to bring their required stationary because maps are more visible. According to Smith et al., (2006) lessons may become more interactive due to the functionalities that the IWB has to offer such as manipulating and animating of images and text and visual information is more easily shared by teachers and learners. Learners' motivation increases in the classroom due to physical interaction with the board as well as there being element of surprise for learners during a lesson; therefore, learners are constantly engaged (Smith et al., 2006). Marzano in Hewitt (2010) also emphasized that IWB can present content knowledge in an interesting manner by using multi-media, which improves learners' engagement.

Limitations to IWB software in the classroom

Smith et al., (2005) stated that for IWB to positively affect teaching and learning it must be used to its full potential and functionality. Teachers must take responsibility in understanding how to use the digital tool to its full potential, before teaching with it. Mercer (2010) indicates that it is not the hardware or software of IWB that influences effective teaching and learning but rather, it is about the users understanding of the use of the digital tool. Hewitt (2006) states

that the teacher must take an interest and the initiative in incorporating technology effectively. Slay et al.'s (2008) research stated that there was a lack of ICT skills which resulted in teachers being discouraged from using ICTs in their classroom, because of the constant difficulty they experienced with South African teachers. This resulted in digital tools not being used appropriately in classrooms. The lack of ICT skills amongst teachers is caused by of a lack of teacher training (Smith et al., 2005). This was also recognized Smith et al.'s later research (2006). Mercer (2010) suggested that this occurs due to the lack of in-service training available to teachers and learners. The problem is not only the lack of teacher training programs but the poor quality of ICT training. Smith et al., (2005) also stated that there must be immediate technical support to eradicate technical difficulties experienced in classrooms. Hewitt (2006) states that there must be patience and understanding of ICT support teams in schools, as well as collaboration amongst teachers using the technology. These factors are lacking in South African schools (Slay et al., 2008).

The positioning of the IWB within the classroom plays a very important role in the visibility of students. If the board is placed in an area where there is too much sunlight, learners cannot see the IWB, this affects teaching and learning negatively (Smith et al., 2005). Hewitt (2006) stated that the board had to be mounted on a wall where there is no sunlight, to avoid glare. Hewitt (2006) also observed that teachers and learners using the IWB during a lesson must be attentive to where they stand in relation to the projector, because they cast shadows onto the IWB. Also, the use of inappropriate colours on presentations impairs learner's visibility. (Smith et al., 2005). IWBs are very expensive and therefore some schools are not able to afford this type of technology, especially with the current economic status in South Africa. Teachers in schools that do manage to buy smartboards mostly do not let learners use them, because they are afraid a learner may break them. Thus, the interactivity is lost and hence the engagement and motivation of learners is lost (Smith et al., 2005). These implications are also relevant to Open Sankoré. Teachers must be aware of the placement of the projector and the whiteboard to avoid impairing the visibility of the map.

2.6 Conceptual Framework

To analyse literature as well as data cohesively it is important to create a conceptual framework. The conceptual framework includes theories that have been discussed within the literature, as well as the connection to how data will be produced. The conceptual framework takes into

consideration the main research question which is: *How does Open Sankoré support teacher's pedagogical needs to teach mapwork skills effectively in Grade 8 and 9 classrooms?*

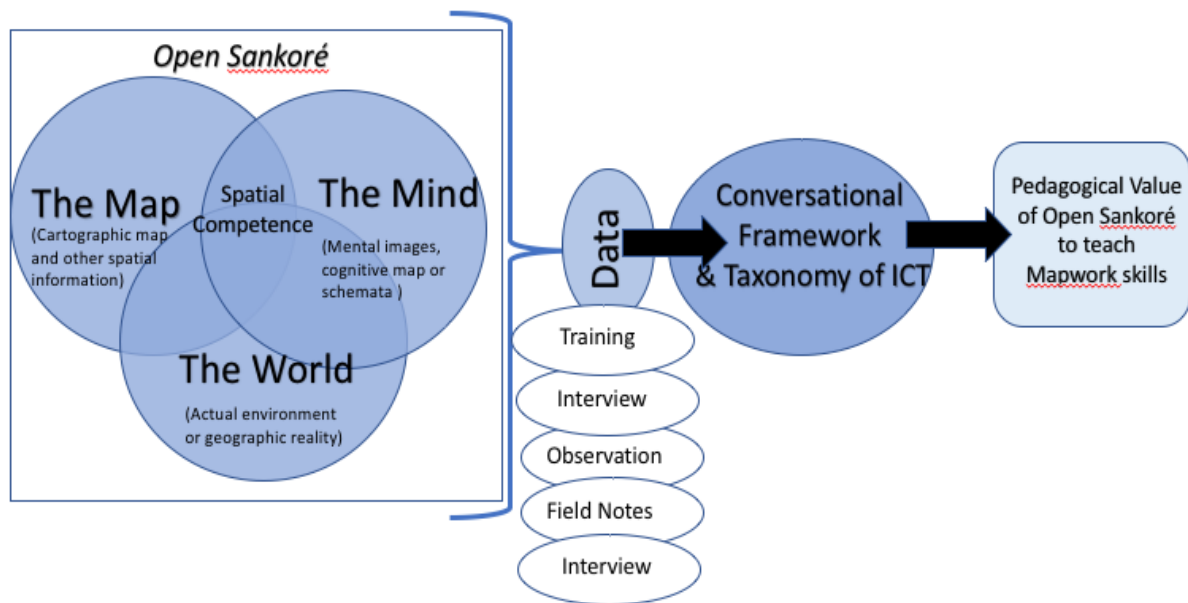


Figure 2 2: Conceptual Framework

The first part of the framework was inspired by Innes (2009) Doctor of Philosophy Dissertation of *Development and Evaluation of a Self-Instruction Method for Analysing Spatial Information*. The conceptual framework considers *spatial competence* important to developing within teachers and learners the ability to have a sound understanding of mapwork skills. *Spatial competence* is the ability to understand space in many contexts. Innes (2009) has separated *spatial competence* into three categories, namely the map, the mind and the world. The conceptual framework considers the three categories of *spatial competence* in relation to Open Sankoré. For Open Sankoré to have pedagogical value within the mapwork field, the software must have the functionalities to access the map, the mind and the world. The study will focus on how Open Sankoré can access the map, the mind and the world. It is assumed in Figure 2.2 that Open Sankoré has access to all three categories, based on the functionalities that are offered.

This assumption is because Open Sankoré can access maps by having scanned images of these maps on the program and therefore teachers and learners always have access to these maps. Open Sankoré has direct access to the Internet as well as google maps and therefore it can access other external environments within Internet sources such as satellite images. The internet is considered as open source and many people around the world participate and contribute to spatial information that is found on the internet therefore there is direct access to

the real world or reality. Teachers and learners can gather more spatial data of whatever area they are learning about by browsing the internet within Open Sankoré. Open Sankoré provides direct links between the physical map and reality and this will create connections and links within the learner's mind.

Raw data was collected through two interviews. The first interview was based on teachers' experiences with Open Sankoré in the training session. The second interview was based on teachers' experiences with the software. Raw data was also collected through field notes and transcripts of the observations. Data was then analysed through Laurillard (2002) media forms, along with Conole and van Dyke's (2004) taxonomy of ICT. The two combinations of ICT frameworks were inspired by Ndlovu's (2015) Doctor of Philosophy Dissertation *The Pedagogical Integration of ICTs by Seven South African Secondary School Teachers* ICT which was where a conclusion was deliberated on Open Sankoré's pedagogical value in teaching mapwork skills.

2.7 Conclusion

The literature has been discussed in three main sections. The first was the *Difficulties teachers face with mapwork skills*. This provided the research with a clear understanding of the difficulties teachers face with teacher pedagogy, within the discipline of mapwork. The definition of Innes (2009) *spatial competence*, assisted the research in understanding the deliberations that must be considered, to improve the teaching and learning of mapwork skills. Innes (2009) definition of *spatial competence* plays an integral role in determining the pedagogical value of Open Sankoré in teaching mapwork skills. The second section was *Instruments that are used to determine Open Sankoré pedagogical value*.

The Laurillard (2002) media forms and the Conole and van Dyke (2004) forms assisted the research to construct a scale that is customized to determining the pedagogical value of Open Sankoré. The last section is about using Open Sankoré as a digital tool to teach mapwork skills, this section of the literature focused on the digital tool itself. This provided the researcher with an in-depth understanding of the educational benefits and limitation IWBs have to offer within the classroom environment. This section also considered the pedagogical considerations in implementing Open Sankoré within the classroom.

Chapter 3: Data Collection Methodology

3.1 Introduction

To conduct research that is meaningful and valuable within a field the researcher must consider an appropriate research methodology (Hancock, 2017). “Selection of the approach to use in a specific research effort depends largely on the goals and preferences of the researcher” (Hancock et al., 2017, p7). The objective of this research is to have a sound understanding of the pedagogical value of Open Sankoré in teaching mapwork skills. Questions such as how? and why? arise from this research; therefore, this research is classified as qualitative research. This is where researchers explain, describe and understand social phenomena (Hancock et al., 2017).

Furthermore, the study is identified as a qualitative case study research because it is “a unique example of real people in real situations, enabling readers to understand ideas more clearly than simply by presenting them with abstract theories or principles” (Cohen et al., 2011, p289). In this qualitative case study, teachers taught a mapwork lesson with the use of Open Sankoré. The ICT tool was used in a classroom context, and the researcher was able to observe the effect that the software had on teachers and learners regarding the teaching of mapwork skills. Therefore, the researcher was able to deduce realistic conclusions of Open Sankoré’s pedagogical value in teaching mapwork skills. According to Cohen (2011), the context of a qualitative case study is very important because it assists researchers in understanding the complex dynamic relationships within a particular event. Using Open Sankoré in a classroom context, created a sound understanding of its pedagogical value regarding the teaching of mapwork skills.

There are many benefits to the qualitative case study methodology. The first benefit of a qualitative case study which is emphasized by Hancock (2017) and Cohen (2011) is that research is based on a real-life context; therefore, human behaviour and interaction is not manipulated, and it leads to a better understanding of social phenomena. The second benefit is that “case studies are highly descriptive” (Hancock, 2017, p18). Case study research produces valuable and in-depth data that can be reinterpreted for other research problems (Cohen, 2011). The third benefit is that case study research insights can lead to an intervention or rehabilitation within the social environment (Cohen, 2011).

3.2 Data Methodology: Descriptive and Intrinsic Research

Yin (2003) and Stake (1995) have produced different classifications of qualitative case study research. This study is categorized by Yin (2003) as a *descriptive case study*. A descriptive case study is describing a phenomenon in the context it has occurred in Baxter et al., (2008). The phenomenon of this research is to find the pedagogical value of teaching mapwork skills, using an ICT tool called Open Sankoré. Descriptive case studies' objective is "to illustrate or explain key features of a phenomenon within its context" (Vernon-Dotson, 2013, p38). The study does this by analysing and explaining the pedagogical value of Open Sankoré for teaching mapwork.

The research also resonates with Stake's (1995) definition of an *intrinsic case study*. This is defined as when researchers "want to know more about a particular individual, group, event, or organization" (Vernon-Dotson, 2013, p38). The research is concentrated on one particular factor; which is gaining a deeper understanding of the pedagogical value of Open Sankoré in teaching mapwork skills. The research questions within the study are very specific. Due to the particularity of the research, generalizations within broader theories of ICT and geography will be difficult to develop.

3.3 Description of Data Collection

Data collection within qualitative case study research requires methods of data collection which can best extract data that will be able to explain, describe and understand social phenomena. The "qualitative approach may require individual interviews, focus groups, observations, a review of existing documents" (Hancock, 2017, p7). The investigation of the study first identified what problems teachers have experienced with mapwork. These problems were identified in Chapter 1. The research then identified a digital tool that could possibly assist teachers with the problems that they have encountered with teaching mapwork skills. This digital tool was identified as Open Sankoré. After the identification was made the research was able to commence.

The research consisted of three teachers from a secondary school in the South of Johannesburg. The three teachers that were selected for the study had to attend one individual training session of one hour. These three teachers formed part of the Social Science department at the school, thus comprising a purposeful sample. After the training session teachers were interviewed to

obtain teachers perceptions, beliefs and values of Open Sankoré before using the software. Teachers then chose one mapwork concept that is in the Grade 8 and 9 syllabi. These topics varied from co-ordinates to distance, direction and bearing. Teachers were observed teaching a particular mapwork topic with Open Sankoré. The lessons were audiotaped to analyse particular themes that assist the research in conceptualizing the pedagogical value of Open Sankoré. This analysis informed the research of affordances that must be taken into consideration when teaching mapwork with Open Sankoré. After the observations were completed, teachers had a second interview after teaching. The purpose of this was to investigate whether teacher's perceptions and attitudes had changed.

Teachers' attitudes and perceptions are vital to the study because in Ndlovu (2015) Gibson (1986) stated that perceptions play a big role in the use of technology. Technology can be interpreted in many ways by teachers. ICTs can be used in a different way from what the ICT was originally designed for (Ndlovu, 2015). This is strongly dependent on teachers' attitudes and initiative to incorporate technology in the classroom (Hewitt, 2010). The analyses will consider Innes's (2009) meaning of *spatial competence*, Laurillard's (2002) Conversational Framework, as well as Conole and van Dyke's (2004) Taxonomy of ICTs.



Figure 3 1: Representation of research procedures

To derive a specific set of data from teachers, specific research procedures must be taken in consideration. Vernon-Dotson (2013) emphasized that once the research design has been

identified data must be collected through procedures such as interviews, observations and documents. These forms of data collection are usually time consuming and difficult to code (Hancock, 2017). Data collection methods within the research are primarily based on teacher's experiences of teaching with Open Sankoré; as well as how teachers taught with Open Sankoré. The research made use of interviews, observation and field notes to collect data. These research procedures were utilized to obtain a sound understanding of teacher's interaction and perspectives of Open Sankoré.

Training session

Before the research commenced there was a collective meeting with all three participants. The participating teachers were briefed on what the research was about. In the meeting instructions were given to the teachers on how to download the software on their laptops. Before teachers were interviewed and observed teachers had to attend an individual one-hour training session. The training session was one-on-one with teachers. This is because it allowed teachers to familiarise themselves with the software without any intimidation or judgement from other teachers or learners. According to Hewitt (2010) the successful adaption of ICT in lessons is based on the level of teacher confidence with the ICT tool. The training session was to boost teacher's confidence for teaching mapwork skills with Open Sankoré.

In addition to the training session a set of suggested lesson guidelines were given to participants before they were taught the specific lesson (see Appendix C). These guidelines were given to teachers, to boost teacher's confidence using the software, while teaching a specific mapwork skill lesson. This also gave teachers ideas of how the software could be used effectively to teach mapwork skills.

The individual training session and lesson guidelines were motivated by Koehler and Mishra's (2009) Technological Pedagogical and Content Knowledge (TPACK) framework. The training session focused on basic skills of running the software, such as how to access and use certain tools on the software such as a pen, ruler, protractor, calculator. (Examples of these functionalities are in Chapter 5). The training session also included how to add the scanned maps that were supplied to teachers onto the software. The training session was structured to improve teacher's technological knowledge of Open Sankoré. The training session also assisted teachers to develop perspectives on the Open Sankoré, which was needed to answer question for the first interview.

Semi-structured interviews

The research procedures of interviewing played an integral role in this case study research. Interviews are regarded as “one of the richest sources of data in a case study and usually the most important type of data to be collected” (Hays, 2004, p229). Researchers can have a better understanding of participants experiences, values, beliefs and interpretation of the social phenomenon that is in question. Researchers can “bring the mind out” through interviews (Cohen et al., 2011).

All interviews within this study followed a semi-structured interview procedure. Semi-structured interviews are when “researchers ask predetermined but flexibly worded questions; which induced tentative answers to the researchers” (Dawson et al., 2011, p47). The purpose of a semi-structured interview is to retrieve vital data that pertains to a single participant’s experiences, beliefs, values and problems (Hancock et al., 2017). Not all participants would have experienced the exact same thing while teaching with Open Sankoré. Semi-structured interviews enabled the researcher to ask certain questions pertaining to each teacher’s individual experiences with Open Sankoré. Two semi-structured interviews took place with each participant. The first interview took place a week after the training session and the second interview took place after the observation. The interviews were used as “the principal means of gathering information having direct bearing on the research objectives” (Cohen et al., p411, 2011). Both interviews assisted in answering the research questions, as well as creating an in depth understanding of the research objectives

Kerlinger (1970) in Cohen et al (2011) constructed three ways in which interviews could be constructed. The first is *fixed-alternative methods* where questions are based on short answers such as yes/no, agree/disagree. In case study research, since it is a study of social phenomena a fixed alternative method can lead to data being vague and many concepts left unclarified. The second method is *open-ended questioning*. This is where the participants are not limited in their answers. Participants can explain their ideas further, leading to more clarity of a concept. There are also disadvantages to open-ended questioning because participants can answer in any way, therefore answers may sometimes be irrelevant to the line of questioning. The third approach is using a *scale approach* where participants must use a scale that measures how much they agree or disagree with the statement. An example of what participants can choose from is strongly agree, agree, undecided. The semi structured interviews used within this study area based on the open-ended line of questioning. This is because with this line of questioning

teachers were able to give in depth explanations, which led to a better understanding of the pedagogical value of Open Sankoré for teaching mapwork skills.

Cohen (2011) emphasizes that “there are kinds of questions which deal with either a general or specific issue” (p417). If the researcher asked general questions the interpretation of data would be generalized within particular educational theories or frameworks. If the researcher asked specific questions, there would be an in-depth understanding of a particular social phenomenon and this would not necessarily coincide with already existing educational theory. A mixed method approach can also be used, where interview questions could be structured from specific to non-specific lines of questioning or vice versa. This is known as the funnel method (Cohen, 2011). Tuckerman (1972) in Cohen (2011) stated that when asking specific questions participants tend to be more guarded, therefore data will be less reliable. Researchers must aim to ask generalized questions. Participants feel less intimidated and answer truthfully.

This specific research uses the funnel method where interviews start off with specific questioning and move towards less specific questioning. The reasoning behind this is informed by Laurillard’s (2002) Conversational Framework and Conole and van dyke’s (2004) Taxonomy of ICT. Questioning must be specific towards the framework to code data accurately. The first interview was focused on the interactions teachers had with the software initially (see Appendix D). These interactions occurred during the training session the week before. The interview was conducted only a week after the training session. This is because it gave teachers an opportunity to explore and engage with the software over seven days. The first interview gathered teachers’ first impressions, as well as their perspectives and apprehensions of teaching with the software. The first interview was also focused on quantitative data, such as how long the participant had been teaching. This was done to identify participants, as well as to construct comparative data within the research. As a result, data would be more valid and reliable by using two types of data forms.

The second interview was based on collecting data on the affordances of Open Sankoré in relation to teaching mapwork skills. More open-ended questions were used in the second interview (see Appendix D). The interview was conducted on the same day as the observations had occurred. The reason for this was that the experience would be more vivid for teachers and therefore they were able to answer the interview questions with more detail. There are many ways that questioning in an interview can be categorized, but this is all dependent on what the research objectives are. In Cohen (2011), Spradley (1979) and Patton (1980) categorized forms

of questioning within an interview. Both interviews make use of two types of questioning: descriptive and experience. Descriptive questioning is where participants can share their values, perspectives and beliefs of teaching with Open Sankoré. Experience questioning is where participants can explain their experience of teaching with Open Sankoré in great depth. Interview questions were aimed at letting teachers describe their experiences with the software within the training session, as well as teaching with Open Sankoré in the classroom.

Observations

Observations were selected as a research procedure because “the interaction of individuals cannot be understood without observation” (Hays, 2004, p230). The observations assisted the researcher in understanding the interactions between the teacher and the software, as well as the interactions between the software and learners. The research will use three dominant theories to make sense of data; which is Innes’s (2009) meaning of *spatial competence*, Laurillard’s (2002) Conversational Framework (CF) and Conole and van Dyke Taxonomy of ICT. Innes (2009) states that for mapwork to be understood correctly, teachers and learners must understand *spatial competence*. in relation to a physical map; the word as well as the mind.

The CF theory states that there are four teaching and learning processes that contribute to effective teaching and learning. These four processes are discursive, adaptive, interactive and reflective. The research will investigate whether Open Sankoré supports these teaching and learning processes. Conole and van Dyke’s (2004) taxonomy of ICT affordances consists of ten ICT affordance characteristics. According to Ndlovu (2015) five affordances are closely related to Laurillard’s (2002) Conversational Framework.

There are five affordances that were used to investigate the pedagogical value of Open Sankoré for teaching mapwork skills. These are: Multimodal and Non-linear, Immediacy, Collaborative, Diversity, Reflection. For the observation, an observation schedule was used to identify the characteristics of the framework within the lesson. The observation was based on Table 3.1, which assisted the researcher in highlighting important details of the observation that informed the Open Sankoré pedagogical value. The table below is the observation schedule that was adapted from Ndlovu (2015), where a study was conducted of seven cases where teachers used ICT in the classroom. Ndlovu (2015) highlighted the pedagogical value of certain ICT tools that were used to teach different subjects. This research will adapt the table to what was observed and apply it to the evidence that was seen in the classroom during Open Sankoré.

Table 3.1 was also used to develop, analyse and interpret data within the study. The table was specifically adapted to the uses of Open Sankoré

Field notes

Field notes were taken during the observations. Field notes can be useful because they provide “the primary data used to verify information collected data” (Hancock et al., 2017, p61). Field notes were used to highlight certain actions or phrases teachers made, in relation to the observation schedule. In this manner, it was much easier to code, because certain links were already made while observing the lessons. In Ndlovu (2015) McNiff, and Whitehead stated that using field notes enhances observations and interviews and highlights the events that took place during the observations. Field notes assist the researcher in reflecting and interpreting events that occurred during the observations (Ndlovu, 2015).

3.4 Sampling

Sample

This research used a purposive sample approach otherwise known as non-probability approach (Cohen et al., 2011). “Purposive sampling strategies are designed to enhance understandings of selected individuals or groups’ experience(s)” (Teddie et al., 2007, p265). The purpose of the research is to investigate the pedagogical value of a digital tool to teach mapwork skills. To investigate this, a group of Social Science teachers must be selected, because they have an in-depth understanding of teaching mapwork skills, as well as the difficulties they face when teaching it. “There is little benefit in seeking a random sample, when most of the random sample may be largely ignorant on particular issues” (Cohen et al., 2011, p157). The selected group is three teachers from a Social Science department at one public school.

The sample is small because the main objective of the research is to investigate the software’s pedagogical value. Whether the research had a hundred participants or three participants, the functionality of the software would remain the same. There would be no need for a larger sample. The research is based on Grade 8 and 9 Social Science teachers at one public school, therefore the FET teachers were excluded from the study. As mentioned, the intermediate phase was chosen because there is an abundance of Grade 8 and 9 learners that do not understand basic mapwork concepts, which filter through to the FET phases. This results in poor performance in mapwork skills in Grade 12 final examinations. This sample is “information rich” cases, which gave the greatest insight in answering the research questions (Teddie et al.,

2007). This type of purposive sampling is known as typical case sampling. This is where “the most typical cases of group or population is under a study” (Cohen, 2011, p157). This group of teachers will be a representation of the population of Social Science teachers in South Africa.

For the participants and the public school to remain anonymous pseudonyms were given to the three teachers that participated in the study. Teachers were characterised as Teacher A, B and C. The public school’s name will not be mentioned throughout the study. Table 3.2 below describes each of the participants.

Table 3.1: Description of participants

Teacher	Qualification	Experience (Years)	Grade that was taught	Content
Teacher A	PGCE-Life Orientation	4	8 and 9	• Co-ordinates • Scale • Gradient
Teacher B	PGCE-Education	6 Months	8	• Co-ordinates • Scale
Teacher C	Bachelor of Education	14	9	• Aerial Photographs • Bearing

Site

As mentioned, the research took place in one public school located in the South East of Johannesburg. It took place in three classrooms, occupied by all three participants. The researcher wanted teachers and learners to feel comfortable within their teaching and learning environment, and therefore the research took place in an environment that the teacher and learners were familiar with, which met the technology requirements.

3.5 Data Analysis

To identify Open Sankoré’s pedagogical value to teach mapwork skills the research heavily relied on the theoretical framework of Laullilard’s (2002) Conversational Framework, Conole and van Dyke’s ICT taxonomy. These frameworks were adapted to Innes’s (2009) definition of *spatial competence*.

An inductive approach was taken, to understand data within this study. The conceptual framework that was produced in relation to the study, is applied to the collected data, to establish conclusions.

An analytical framework was developed in Ndlovu (2015) that assisted the study in understanding the pedagogical value of different ICTs. The same analytical framework was also used as a tool, to investigate Open Sankoré pedagogical value in teaching mapwork skills. This analytical tool that was used in Ndlovu (2015) was also used in the study as the observation schedule within this study (Refer to table 3.2 below).

Table 3.2: Observation Schedule

Media forms	Affordances →	Evidence	→ What pedagogical value does it add?
Narrative	Non-linear	Multimodality	Apprehending structure/ connections
Interactive	Immediacy	Immediate feedback	Exploring: misconceptions amended
Communicative	Collaboration	Discussion: class/ group	Re-descriptions of concepts
Adaptive	Diversity	Reproduction: experiment/ role play	Concretising theory: practice
Productive	Articulation	Product: animation/model	Knowledge construction

The table above represents a combination of Laurillard's (2002) CF, as well as Conole and van Dyke's (2004) taxonomy of ICT. Six teacher practices also assisted the research in deciphering whether Open Sankoré was of pedagogical value, in particular for the subject of geography. (Refer to Table 2.1). It also assisted the researcher to design meaningful lessons plans that were given to teachers during the training session. The lesson plans also served as a form of guidance for teachers to incorporate Open Sankoré.

Laurillard's (2002) Conversational Framework has indicated that for any ICT to have any pedagogical value, it must support teacher and learner mediation through discursive processes, adaptive processes, interactive processes as well as reflective processes. Open Sankoré was studied and categorized as Narrative, Communicative, Adaptive and Productive media. The categorization indicated what kind of learning processes the digital tool supported. The less processes a digital tool supports, the less effective the digital tool for teaching and learning.

To understand the true pedagogical value of a digital tool it is also important to highlight the affordances that are present within the digital tool. The affordances of a digital tool may affect

the usability of the tool in an educational context. Therefore, Conole and van Dyke's (2004) taxonomy of ICT affordances would be able to establish the existing affordances within Open Sankoré. This taxonomy was used because some of the themes within the taxonomy are closely related to Laurillard's (2002) CF. Open Sankoré was analysed and interpreted through the following themes: Taxonomy; Multimodal and Non-linear, Immediacy, Collaborative, Diversity and Reflections. This assisted the research in developing a sound understanding of the affordances that exist within Open Sankoré, as well as understanding whether these affordances affect the pedagogical value of the digital tool (Ndlovu, 2015).

The interviews and observations of each case study were transcribed from audio recordings. Field notes were also used to interpret data. According to Shank et al., (2006), the researcher must be innovative and interpret findings in a manner where it is useful to the education field. Transcription of observations and interviews played an integral role in interpreting data. Interpreting of data is also known as coding. Kerlinger (1970) in Cohen (2011) describes coding as: "the translation of question responses and respondent information to specific categories for analysis" (p428). Coding is the process of categorizing data into certain groups or themes (Freeman, 2017). The transcripts in the study provided evidence of regularity and continuity of social phenomena. Extracts of observations or interviews that included significant teacher's practices, actions and speech that linked to the conceptual framework, were used to make a sound argument of the pedagogical value of Open Sankoré. Field notes were also used to reiterate an important event that took place during an interview or observation. Field notes were also used to clarify ambiguity within the interviews or observations (Ndlovu, 2015). In the data analysis, there must be summaries of "inferences from text, patterns, regularities and relationships between segments and text" (Cohen, 2011, p585) regarding the analytical framework. Through these processes themes developed from the study which allowed for certain inferences to be made.

3.6 Issues of Reliability and Validity

Qualitative researchers must ensure that there are detailed recordings of data collection for their data to be considered as valid (Mays et al., 1995). In qualitative research, the concern for data is that it is reliable and valid. A qualitative researcher's main goal is to enable other researchers to use their data for other studies in the field (Mays et al., 1995). The qualitative approach allowed "researchers to have a much clearer understanding of the challenges involved in producing good qualitative work and of techniques that can be used to ensure its

trustworthiness” (Sandelowski, 1993, p1). For researchers to do this there must be an organized method where data is analysed, interpreted and discussed in conjunction with set theories and frameworks. This allows for credibility of the research.

This study is focused on the pedagogical value of a digital tool to teach mapwork skills. Therefore, it studies existing theories such as Laurillard’s (2002) CF and Conole and van Dyke’s (2004) taxonomy of ICT. To make the research findings reliable, other theories are also taken into consideration such as the Vygotsky term of mediation. Innes (2009) has also done a considerable amount of research on effective teaching methods, to improve mapwork skills in South African classrooms, which the research will rely on to draw certain conclusions. Chandler and Munch (2016) six teaching practices also contributed to drawing certain conclusions about the software.

To ensure valid data there is a “basic strategy to ensure rigor in qualitative research is systematic and self-conscious research design, data collection, interpretation, and communication” (Mays et al., 1995, p110). The way data was collected was through oral interviews and observations which were audio-recorded. Audio taping interviews and observations ensured reliability of the research. This was because there was evidence that the interviewees, teachers and learners were not manipulated in answering questions or doing something they did not want to do during the observations. All interviews and observations were transcribed to keep a record of their existence. A date and time of interviews and observations was recorded to show evidence that interviews were not falsified. Written notes were taken down during the observations to record important gestures or points that the researcher felt should be emphasised during the research analysis. The written notes may also show reliability of the information within the observation, because there is evidence that the information was not skewed or manipulated.

3.7 Ethical Considerations

Research that involves human entities, which is common within the humanities field, must be approached with caution and sensitively. Researchers must ensure that there are “tight constraints to be placed on the release of data, in order to protect the identity of the data subject and to preserve the level of trust required to sustain the research” (Pryor, 2012, p86). To conduct research that does not infringe on ethical boundaries, ethics approval must be granted within an ethics committee, and research must be approved by the Gauteng Department of Education (GDE). In this case an ethics application was submitted to the ethics

committee at the faculty of Education at the University of the Witwatersrand, as well as the GDE. Ethical considerations for the research were approved by the ethics committee at the University of the Witwatersrand, as well as the GDE (see Appendix E). The protocol number for this research is 2017ECE011M.

To respect ethical boundaries of all individuals that participated in the research, certain procedures and protocols took place before the data collection could commence. First, the school that was involved in the research was approached about conducting the research. The principal was contacted, and a meeting was held between the principal and the researcher. In the meeting, the research project was explained, and the researcher's intentions were clarified. An information sheet (see Appendix F) was given to the principal, to clarify any ambiguity or uncertainty on what the research was about, and when and how the research would be conducted.

Once management was informed about the research, and permission was granted to conduct research in teacher's classrooms, a meeting was held with teachers that were participating. In the meeting teachers were explained what will be required of them to participate in the research, how and when will the research will be conducted. In the meeting teachers were handed information sheets as well as consent forms (see Appendix E). Once teachers had signed the consent forms and were willing to participate in the study, teachers had to select their own Social Science classes where they would be observed teaching with Open Sankoré.

A meeting was then held with all learners, where the research was explained and when and how the research would be conducted. Learners were handed information sheets, as well as consent forms for themselves, as well as for their parents (see Appendix E). It was made clear to all participants within the study, that they would remain anonymous and information given towards the research project was confidential. To keep participants anonymity, pseudonyms were used in the transcripts and interviews. Once all consent forms were returned from all participants the data collection process started.

3.8 Conclusion

In this Chapter all, methodological procedures have been influenced by the conceptual framework. The methodology as well as the literature have contributed in producing accurate and reliable data. The data contributed to the data analyses which has produced some insightful results. This has contributed to answering the research questions as well as possible. Ethical

considerations for the research were approved and procedures were put into place to ensure reliability and validity of the research.

Chapter 4: The Development of the Analytic Framework

4.1 Introduction

To decipher qualitative data that is valuable and accurate, raw data sets must be organized and structured into patterns of similarity or common occurrence, which are known as themes. “Themes are the classification of more discrete concepts” (Ryan & Bernard, 2003, p87). Themes are essentially the main components of the research which give the most in-depth explanations of data. The explanation of data within themes will allow a profound analysis of research questions. Themes are derived from the literature review, as well as the conceptual framework. Ndlovu (2015) developed a scale that is derived from two analytical frameworks: Laurillard’s (2002) forms of media, and Conole and van Dyke’s (2004) taxonomy of ICT. The research is specific to mapwork skills and teaching. Therefore to produce valuable data, the conversational framework was not enough to make sense of data. The research also considered Innes’s (2009) definition of *spatial competence*. This is because *spatial competence* plays a vital role in understanding mapwork skills; therefore the research finds patterns within the data sets that associated with the presentation of spatial data within Open Sankoré.

The analytical tool which was used in Ndlovu (2015) was also used to analyse and interpret in this chapter (see Table 3.1). The analytical tool guided the study to develop the following themes within the research, namely: *media forms, affordances, evidence and what the pedagogical value was*. Each participant interpreted Open Sankoré differently and therefore different media forms were used in each lesson. The evidence varied from one participant to another, which was specific to Open Sankoré that related to each theme mentioned above.

This research is specific to teachers and mapwork skills. The themes mentioned above are generalized and they did not cover these components of the research, therefore additional themes were considered to produce reliable and accurate data. These themes were *teachers’ perceptions and attitudes, the adaptability and usability of Open Sankoré to teach mapwork skills in relation to Innes’s (2009) definition of spatial competence and the pedagogical value of Open Sankoré towards teaching mapwork skills*.

4.2 Existing Themes

Conversational framework and taxonomy of ICT

Laurillard’s (2002) media forms are intended to support the learning process within the conversational framework (Ndlovu, 2015). The term media refers to tools that enhance the

learning process, in this case one digital tool which Open Sankoré used is highlighted (Ndlovu, 2015).

The value of the ICT is determined “when content is designed in such a way that structure and connections are made easy for learners to grasp” (Ndlovu, 2015, p106). Although the forms of media are a good indication of ICTs that can have pedagogical value, it is important to consider the affordances of the ICT and how can these affordances of the ICTs affect the learning process. Ndlovu (2015) stated that using the ICT taxonomy is important because it assists the research in identifying media forms, and what kind of learner engagement is created by using the ICT. Affordances are considered an important factor when dealing with ICTs. Affordances deal with unseen circumstances of the ICT as well as with how individuals create innovative methods in dealing with them (Conole & van Dyke, 2004). The media forms deal with the physical outcomes of learning, while the ICT taxonomy deals with the unseen outcomes of the ICT.

Media forms

Narrative media

Table 4.1: Use of Open Sankoré as a Narrative media form

<i>Media Forms</i>	<i>Affordance</i> →	<i>Evidence</i> →	<i>What pedagogical value does Open Sankoré add to mapwork skills? (the map, the mind, the world)</i>
Narrative	Non-linear	Multimodality: Visual or textual representation of mapwork concepts: • Import image function • Magnifying glass • Text box • Highlighter Electronic Pen	Apprehending structure: <i>The map:</i> Learners are exposed to a scanned topographical map which is projected onto a whiteboard through Open Sankoré. <i>The mind:</i> Creating links between existing mapwork knowledge and new mapwork knowledge. <i>The world:</i> Teachers highlight or emphasise on certain mapwork concepts on Open Sankoré.

The first part of Table 4.1 is narrative media. Narrative media is defined as media that creates a comprehensive and holistic understanding of a certain concept. This is done by creating links and connections of components within a certain concept (Laurillard, 2002). The aim of narrative media forms is to show or represent concepts for learners. These types of media are

based on the presentation of a concept, and therefore are known as being non-interactive forms of media (Ndlovu, 2015). Teachers are simply telling and showing learners concepts which lead to linear learning patterns.

Narrative media forms encourage the learning process of apprehending structure within the CF. Teachers must scaffold mapwork concepts such as: co-ordinates, distance, direction and scale, by linking them to pre-existing knowledge. This is emphasised by Chandler and Munch (2016) who show that to improve geographical enquiry, teachers must link new knowledge to pre-existing knowledge, for learners to understand geographical concepts. In addition, Innes (2009) states that, to have a sound understanding of mapwork concepts, teachers must access cognitive maps or schema within the mind of the learners. To do this, teachers must link new knowledge to pre-existing knowledge, through the process of mediation. Laurillard (2002) highlights that it is not just about what technology is used for, but that also it is important to know how it is used to create communication between teacher and learner.

According to Laurillard (2002), for effective learning to occur in terms of the CF, narrative forms of media must be used in the classroom, where learners are interacting and engaging with content knowledge. “In the narrative form, the teacher describes the new concept while interacting with learners” (Ndlovu, 2015, p108). In this instance the teacher is using Open Sankoré to explain concepts such as distance, gradient and co-ordinates on a scanned map. There is a link to Open Sankoré being used as a narrative media form to Innes’s (2009) definition of *spatial competence to the map and the mind*. By means of the teacher using a scanned Topographical and Orthophoto map, there is a strong visual presence. Teachers and learners always have access to the *cartographic map* because it is projected onto the board. According to Innes (2009), to improve *spatial competence*, learners must always have direct access to the physical map.

The teacher would use the import image option to insert a scanned Topographical or Orthophoto map. The teacher may use a magnifying glass on Open Sankoré to zoom in on relevant areas on the map. If the teacher is teaching co-ordinates with Open Sankoré, the teacher can use the magnifying glass to zoom in onto a line of latitude and a line of longitude. The teacher could use a pen or a highlighter to show learners what lines they were referring too. Teachers can also fill the missing co-ordinates on the map, by using a text box to show learners how to fill in missing co-ordinates on a map. The teacher may use a pen or highlighter to emphasises where learners can find certain spatial data on the map, such as a ratio scale and

a line scale. For Open Sankoré to be considered as a narrative media form, multimodality must be evident within the teachers' observation. Therefore, there must be a strong visual presence of mapwork concepts for learners.

Interactive

Table 4.2: Use of Open Sankoré as an interactive media form

<i>Media forms</i>	<i>Affordance</i> →	<i>Evidence</i> →	<i>What pedagogical value does Open Sankoré add to mapwork skills? (the map, the mind, the world)</i>
Interactive	Immediacy	Immediate Feedback Assessment of mapwork concepts verbally or textually	Exploring Misconceptions amended: <i>The Map:</i> Learners can identify what they do not understand on the cartographic map <i>The Mind:</i> Learners can ask questions on specific steps of a calculation that do not fit with their own cognitive map. Learners re-do steps based on what the teacher has done on digital topographical map. Cognitive map is adjusted. <i>The world:</i> Presenting mapwork calculations in a step by step process, where learners can visibly see where they went wrong.

Interactive media forms are defined as media forms where only the user has control of the ICT. In this case Open Sankoré is only used by the teacher, and therefore the teacher has control of the ICT. Laurillard (2002) states that ICT that allows their user to select and sort through content independently is interactive. Even though learners do not have access to the ICT itself, the ICT assists the teacher to mediate new concepts into the learners already existing cognitive map. If new knowledge is not accommodated into the cognitive map, learners are able to communicate with the teacher, in order gain more clarity of new concepts and therefore the media form is considered interactive (Ndlovu, 2015).

Teaching with Open Sankoré in the interactive media form can assist teachers in addressing mapwork misconceptions. The researcher has experienced that learners struggle with concepts such as working with degrees, minutes and seconds; applying the distance formula and

applying the gradient formula on a Topographical map. While the teacher is showing learners how to do specific steps of a calculation on the digital Topographical map, there are significant links to Innes's (2009) definition of *spatial competence*. In the interactive media form, all aspects of *the map*, *the mind* and *the world* are considered. By the teacher simply engaging with the Topographical map on Open Sankoré, learners can identify what they do not understand on the *cartographic map*. As the teacher guides learners through steps of a specific calculations, learners are accommodating new knowledge into their already existing cognitive maps, by constantly asking questions therefore, there is direct access to *the learner's mind*. The constant communication between teachers and learners encourages the learning process of exploring misconceptions within the CF. This learning process is also like accessing *the world*, because learners are interacting with the teachers and Open Sankoré. This is considered as the external environment, and therefore learners are engaging in the real world.

The affordance that must be taken into consideration is immediacy. This is referring to how fast communication occurs between teacher and learner. The faster the communication between teacher and learners occurs, the faster the teacher can pick up on misconceptions the learners may have and amend them. The learner should express newly amended concepts to the teacher for the teacher to judge whether the learner has understood the concept. This feedback loop between teacher and learner must be present when dealing with interactive media forms. Innes (2009) states that in her self-instructional method; to enhance the understanding of *spatial competence* within learners, immediate feedback is imperative. Therefore, Open Sankoré must provide evidence of an assessment of mapwork concepts, whether it be formal or informal. If Open Sankoré is considered as an interactive media form, there must be evidence within the observation that immediate feedback is given to teachers from learners, and that teachers are making amendments to learners' mapwork misconceptions

Communicative

Table 4.3: Use of Open Sankoré as a communicative media form

<i>Media forms</i>	<i>Affordance</i> →	<i>Evidence</i> →	<i>What pedagogical value does Open Sankoré add to mapwork skills? (the map, the mind, the world)</i>
Communicative	Collaboration	Discussion: Class/Group • Communication of mapwork concepts with teacher/learner. • Map interpretation • Switching between maps (Able to recognize a maps functionality) • Learner agency	Re-description of concepts: <i>The map:</i> Learners engage with their own static map and apply mapwork processes independently. <i>The mind:</i> Learners synthesize mapwork knowledge within their cognitive maps and apply it to a discussion with learners or teacher to reach a conclusion. <i>The world:</i> Learner and teacher interaction.

Communicative forms of media are defined as ICTs, which can be operated in a group discussion or in any social learning activity that involves communication between one or more parties (Ndlovu, 2015). Communicative forms of media encourage discursive learning processes in the CF (Ndlovu, 2015). It must be highlighted that Laurillard (2002) and Conole and van Dyke (2004) define the ICT strictly as communication online. Examples of this can be; having a class discussion on social media or the internet. Ndlovu (2015) emphasises that the communicative form of media is not strictly reliant on online activity. The ICT can promote a discussion in the classroom environment and allow learners to develop higher-order thinking skills. This is an important skill to have within the mapwork, because learners can apply mapwork knowledge to everyday life. It is emphasised by Chandler and Munch (2016) that to improve geographical pedagogy, teachers must link geographical concepts to real world problems. “The ICT affordance may provide a stimulus or a platform that might initiate the conversation in the collaboration process” (Ndlovu, 2015, p110). This means that learners can synthesize new knowledge and prior knowledge, to apply it to solving problems within the classroom as well as in everyday life.

Collaborative media forms also encourage collaboration amongst teachers and learners to reach particular learning goals. Teaching with Open Sankoré within the classroom environment, may assist teachers in reaching learning goals such as getting learners to comprehensively understand how to do mapwork calculations such as co-ordinates, distance and gradient, as

well as getting learners to understand why these important skills need to be mastered within the Social Science curriculum.

For Open Sankoré to be considered as a collaborative medium, there must be evidence within the observation that teachers and learners are communicating with one another. Activities such as group work, where learners are discussing mapwork concepts of that lesson can contribute as evidence towards a collaborative media form. Learners who can apply new and existing mapwork knowledge cohesively, to solve a particular mapwork problems also contribute as evidence towards this media form. The learner must be able to explain why an area is dry; or why there is cultivated land; by simply looking at the map. Both these attributes have a strong link to *the world* because learners are applying knowledge to the external environment.

Innes (2009) does not make mention that discussion is important to enhance *spatial competence*, but she does highlight that learners must be able to work on their own and at their own pace, to understand mapwork skills. However, the researcher does find importance in the discussion of mapwork concepts between learners and the teacher. This activity provides evidence that the learner is applying their mapwork skills in a different context, and therefore it shows an in-depth understanding of content knowledge. Discussion of mapwork concepts also encourages discursive learning processes within the CF because learners must express their own agency when they are partaking in a discussion. When learners are left to their own devices, higher order thinking skills are developed. In this research, the learners not only have access to a digital map that is projected onto the board, but each individual learner has access to a static map. If the learners are independently working with their own map whether it be on Open Sankoré or the static map, the learner has access to work independently on the *cartographic map*. For Open Sankoré to be considered as a collaborative media form there must be evidence of learners working independently on a map.

Adaptive

Table 4.4: Use of Open Sankoré as an adaptive media form

<i>Media Forms</i>	<i>Affordance</i> →	<i>Evidence</i> →	<i>What pedagogical value does Open Sankoré add to mapwork skills? (the map, the mind, the world)</i>
Adaptive	Diversity	Reproduction: Experiment/ Role play ▪ Creating mapwork activities ▪ Switching to different maps ▪ Import image function ▪ Shapes ▪ Colour ▪ Line ▪ Text ▪ Electronic Stationary (Rulers, Protractors)	Concretising Theory: Practise <i>The map:</i> Learners are able to analyse and synthesize spatial data on the map to gather appropriate information. <i>The mind:</i> Learners synthesize their cognitive maps and apply mapwork knowledge to problem solving. <i>The world:</i> Apply mapwork skills to real life situations or community problems.

Adaptive media are media forms that can change according to the user's responses (Laurillard, 2002). Adaptive media forms are beneficial because they offer the user intrinsic feedback. Intrinsic feedback is "internal to the action, cannot be helped once it occurs" (Laurillard, 2002, p126). Users are exposed to feedback that comes directly from the ICT, unlike communicative types of media, that rely on constant responses from teacher and learner. Adaptive forms of media afford diversity, because the ICT will adapt to learner's responses and therefore learners are able to work at their own pace. Innes (2009) highlights that learners must be able to work at their own pace to internalise mapwork concepts. Although it seems that learners must have direct access to Open Sankoré for it to be considered an adaptive media form. Ndlovu (2015) does highlight that a learning environment that connects learners to the real world can be achieved without direct use of the ICT. Therefore, Open Sankoré can still be considered as having pedagogical value within this media form, depending on how the teacher uses the ICT within the classroom environment,

The adaptive media form is focused on transferring theoretical knowledge into practice. This media form pertains to the adaptive phase of the CF. "When theoretical perspectives have been presented, this medium can be used by the teacher to give learners a virtual concrete experience of the concept" (Ndlovu, 2015, p111). Learners can experience content knowledge beyond the classroom, and knowledge becomes more relative to the real world. For Open Sankoré to be considered an adaptive media form, learners must show evidence of understanding mapwork

concepts by applying them to real life situations or community problems, this factor has a direct link to *the world*. This is because learners are applying their mapwork skills to the real world. Learners must be able to analyse spatial data on a Topographical map, to solve problems within the community. Learners should be able to analyse and engage with the map on Open Sankoré. Therefore, learners need direct access to the *cartographic map*, to gather information about the community. For learners to apply knowledge to real life situations, learners must synthesize and organize cognitive maps and use the appropriate knowledge to problem solve. There is a direct link to *the mind*, because learners must access their existing cognitive maps. It must be highlighted that for learners to express this type of learning process, the learner should have direct access to Open Sankoré for it to be considered an adaptive media form

Productive

Table 4.5: Use of Open Sankoré as a productive media form

<i>Media forms</i>	<i>Affordance</i> →	<i>Evidence</i> →	<i>What pedagogical value does Open Sankoré add to mapwork skills? (the map, the mind, the world)</i>
Productive	Articulation	Production: Animation/Model - Creation of maps - Create new teaching resources within Open Sankoré - Import image function - Shapes - Colour - Line - Text - Google Maps	Knowledge construction: <i>The map:</i> The use of different maps to create their own spatial data. <i>The mind:</i> Learners synthesize their cognitive maps and apply mapwork knowledge to create. <i>The world:</i> Teachers and learners create their own spatial data on Open Sankoré.

In productive forms of media teachers must utilise the ICT to create activities where the learners are encouraged to use the knowledge that they have learnt and produce something with the ICT or online (Ndlovu, 2015). Productive media forms encourage the interactive and reflective phases of the CF. This is because content knowledge is mainly explored by learners, and therefore they can interact and reflect on content knowledge. In this study the teachers are the main users of the ICT. Ndlovu (2015) states that even though the use of the productive media form is not relevant through the teachers use of other media forms, this may equip learners with the necessary modes of thought and skills to produce content knowledge with

ICTs in future instances. For instance, if learners had access to Open Sankoré it would support Innes's (2009) development of *spatial competence*.

In the productive media form, teachers and learners can use the ICT to create their own maps, to represent spatial data of a certain area. Teacher and learners would be able to express mapwork concepts such as co-ordinates, scale, direction and gradient. Teachers can use the productive media form to create their own teaching resources for mapwork. Learners can interact with mapwork content knowledge, by extracting data from certain maps, to create their own. Open Sankoré can facilitate this activity, because a variety of maps can be imported onto the digital tool. Teachers and learners have direct access to not just one *cartographic map* but a variety of them. This has a link to the foundations of Geographic Information Systems (GIS) because learners are gathering specific data on a specific area, from various maps and layering that information on one map only. To create spatial data teachers and learners would synthesize and organize their *cognitive maps*. Teachers and learners would then apply relevant mapwork concepts to the map they are producing. To express this knowledge in the external environment, teachers and learners can use Open Sankoré to create their own map and therefore there is a link to *the world*.

In this research learners do not have direct access to Open Sankoré, and therefore the productive media form is not used and therefore its pedagogical value within this media form towards teacher and learners is limited. For Open Sankoré to be considered as a productive media form within this research there must be evidence of teachers creating their own mapwork resources by using Open Sankoré. Although using the *cartographic map* on the software is considered a resource, the teacher does not create his/her own *cartographic map*. However, teachers can use Open Sankoré to create their own assessments or mapwork activities.

Table 4 6: The use of Laurillard (2002) media forms and Conole and van Dyke (2004) taxonomy of ICT is adapted to the use of Open Sankoré towards teaching mapwork skills

<i>Media forms</i>	<i>Affordance</i> →	<i>Evidence</i> →	<i>What pedagogical value does Open Sankoré add to mapwork skills? (the map, the mind, the world)</i>
Narrative	Non-linear	Multimodality: Visual or textual representation of mapwork concepts • Import Image function • Magnifying glass • Zoom in and zoom out function • Text box • Highlighter • Electronic pen • Shapes	Apprehending structure: <i>The map:</i> Learners are exposed to a scanned topographical map which is projected onto a whiteboard through Open Sankoré. <i>The mind:</i> Creating links between existing mapwork knowledge and new mapwork knowledge. <i>The world:</i> Teachers highlight or emphasise certain mapwork concepts on Open Sankoré.
Interactive	Immediacy	Immediate feedback: • Assessment of mapwork concepts verbally or textually	Exploring Misconceptions amended: <i>The map:</i> Learners can identify what they do not understand on the cartographic map. <i>The mind:</i> Learners can ask questions on specific steps of a calculation that do not fit with their own cognitive map. Learners re-do steps based on what the teacher has done on digital topographical map. Cognitive map is adjusted. <i>The world:</i> Presenting mapwork calculations in a step by step process where learners can visibly see where they went wrong.

Communicative	Collaboration	Discussion: Class/Group: • Communication of mapwork concepts with teacher/learner. • Map interpretation • Switching between maps (Able to recognize a maps functionality) • Learner agency	Re-description of concepts: <i>The map:</i> Learners engage with their own static map and apply mapwork processes independently. <i>The mind:</i> Learners synthesise mapwork knowledge within their cognitive maps and apply it to a discussion between learner and teacher to reach a conclusion. <i>The world:</i> Learner and teacher interaction.
Adaptive	Diversity	Reproduction: Experiment/ Role play: ▪ Creating mapwork activities ▪ Switching to different maps ▪ Import image function ▪ Shapes ▪ Colour ▪ Line ▪ Text ▪ Electronic Stationary (Rulers, Protractors)	Concretising Theory: Practise <i>The map:</i> Learners can analyse and synthesize spatial data on the map to gather appropriate information. <i>The mind:</i> Learners synthesize their cognitive maps and apply mapwork knowledge to problem solving. <i>The world:</i> Apply mapwork skills to real life situations or community problems.
Productive	Articulation	Production: Animation/ Model: ▪ Creation of maps ▪ Create new teaching resources within Open Sankoré ▪ Import image function ▪ Shapes ▪ Colour ▪ Line ▪ Text ▪ Google Maps	Knowledge construction: <i>The map:</i> The use of different maps to create their own spatial data. <i>The mind:</i> Learners synthesize their cognitive maps and apply mapwork knowledge to create. <i>The world:</i> Teachers and learners create their own spatial data on Open Sankoré.

Table 4.1 as seen above was adapted to the research, to focus on Open Sankoré's pedagogical value to teaching mapwork, to have an accurate and reliable outcome of the research and formed the basis of the analysis of the pedagogical value of Open Sankoré.

The table is organized from simple to complex learning processes, and what types of activities will encourage these learning processes. The first column is Laurillard's (2002) five media forms which support the CF. The second column is Conole and van Dyke's (2004) five components of the taxonomy of ICT. These five components were chosen because Ndlovu

(2015) found them to be the most flexible and had more connections to the specific media forms. This will be explained later in the chapter. The third column describes the learning activities that should take place within the lesson, to encourage learning processes. The third column was changed to evidence that showed connection to the map, the mind and the world. This assisted the research in understanding the effect Open Sankoré has on learners in enhancing their understanding of *spatial competence*. When it is applicable some evidence comprises functionalities of Open Sankoré, which supported specific learning processes. The fourth column considers how Open Sankoré supported spatial competence through the map, the mind and the world. One of the benefits of Open Sankoré is that the physical map is always accessible to teachers and learners; therefore no matter what media form Open Sankoré supports the physical map will always be accessible. The learning processes that are in the fourth column are directly related to the CF, as well as to Innes's (2009) definition of *spatial competence*. The combination of the media forms, the affordances and how the teacher interacts with Open Sankoré during teaching, will inform the research of its pedagogical value (Ndlovu, 2015). The arrows in the table make the connection between affordances, the evidence and the pedagogical value (Ndlovu, 2015).

Innes (2009) states that there is no way to measure the population's *spatial competence*, but the more exposure there is to spatial information the more this can lead to the enhancement of *spatial competence*. Table 4.1 supported the research because it stipulated how Open Sankoré was relevant in the specific media form, to teach mapwork skills. The newly adapted table takes into consideration the relationships between the map, world and mind. As the table moves on from simple to complex learning processes, the relationship between the map, world and the mind also becomes more complex, due to the complexities of the learning processes. If Open Sankoré can connect the map, the world and the mind cohesively, it will be regarded as having pedagogical value in the respective media form.

4.3 Support of Pedagogy for Mapwork Skills

In addition to Ndlovu's (2015) analytical tool, a theme that emerged through the research was *support of pedagogy for mapwork skills*. Open Sankoré acted as a tool of mediation for mapwork skills. The author has not found any reference to Open Sankoré being used in this way before, and therefore the functionality is different from what it was originally designed for. Mediation is Vygotsky's term for how information is broken down, for it to be transferred from one individual to another. Slay et al., (2008) emphasized that IWB assisted in facilitating the learning process, by having strong visual presentation of content knowledge. This is also

highlighted in Schonborn and Anderson's (2005) study, that highlights using visualization tools, the assistance given to medical students for them to have a better understating of the structures of the body; especially micro structures such as body cells. Wall, Smith and Higgins's (2005) study highlighted that with the use of IWB, learners knew exactly what the teacher was talking about. There are many studies that have proved that IWB is useful to ICT to mediate content knowledge. Although Open Sankoré functionality is very specific in this study, which focuses on only teaching mapwork skills with the software; particular tools that teachers used to teach mapwork skills such as co-ordinates, distance, gradient and direction may have enhanced teacher pedagogy. Therefore, this theme unpacks the tools within Open Sankoré, that enhanced teacher pedagogy.

4.4 Usability and Adaptability

A theme that emerged from the research was *usability and adaptability of Open Sankoré*. This theme highlighted how easily teachers incorporated Open Sankoré into their pedagogy. Mercer et al., (2009) highlighted that the judgement of using the IWB is not on how tech-savvy the teacher is with the software, but on how the IWB software is used to convey knowledge to learners. Mercer et al., (2008) also established that the easier it is for teachers to incorporate technology in their lessons to mediate knowledge, the more it will encourage constant communication between teacher and learner.

Hewitt (2010) states that teachers tend to shy away from ICT because there is a lack of knowledge of how to incorporate ICTs effectively in the classroom. This is also emphasised by Slay (2008) who says that the lack of knowledge teachers had on the functionality of the ICT, the less productive lessons were. "Colleagues who were not ICT literate tried to use computers but became so discouraged by their failure that they gave up on using all ICTs" (Slay, 2008, p1333). Teachers who find it difficult to use digital tools in a classroom context will be less eager to incorporate them in their pedagogy. Hall and Higgins (2005) state that teachers who do not have basic ICT skills will result in ineffective use of technology in the classroom. Slay (2008) also highlighted that teachers may be ICT literate but are not competent enough to convey knowledge to learners with effective use of ICT. These difficulties that teachers experience with ICT can stem down to ineffective professional development and training programs. Slay (2008) and Hewitt (2010) suggest that there must be ongoing teacher development programs so as to effectively incorporate e-beam and IWB technology in the classroom.

For Open Sankoré to have any significance in the teaching of mapwork skills it is important to highlight how easily teachers incorporated it into their pedagogy; as well as how easy it was for the teachers to use it. The theme also highlights the usefulness of the training session that the three participants had to take part in, as well as the overall experience the teachers had when teaching with Open Sankoré to Grade 8 and 9 learners.

4.5 Additional Considerations for the Research

Teacher attitudes, value, beliefs and perceptions of the use of Open Sankoré

Teachers' attitudes, beliefs, values and perceptions of ICT play an integral role in the successful incorporation of technology within their pedagogy. Attitudes, beliefs, values and perceptions of an individual form part of their knowledge base. According to Dirkx, Kielbaso and Smith (2004) in Mbane (2009) "the way teachers view knowledge and how it is acquired determines the teaching strategies they will use." If teacher's perceptions of the use of ICT in the classroom is negative, ICTs may not be used as effectively. This is emphasised by Lai, Pratt and Trewern (2001) in Mbane's (2009) study which stated that teacher's attitudes, beliefs and values effect the teachers' use of ICT in the classroom.

In a study conducted in England on primary school's teacher's perceptions of ICT is based on: *"Teachers' identity and participation in wider cultural and social spheres that influence the professional arenas and settings in which they practice"* (Loveless, 2003, p99).

Teachers' perceptions of ICT are not solely based on policy and curriculum. They are also based on the personal experiences that they have had with ICT on a professional or personal level. These experiences may impact their willingness to incorporate ICT in their pedagogy. Loveless (2003) also highlighted that investigating teachers' perceptions of ICT are important because they reveal teachers' personal understanding of the meaning of ICT and its importance within education. It is "imperative to understand teachers' underlying epistemological assumption; especially when it comes to the use of technologies within the classroom situation" (Mbane, 2009, p13). It is also important to understand that teachers' epistemological belief systems because this will affect the way in which technology is used in the classroom. Teachers that have a behaviourist or cognitive approach to teaching the ICT use it in the way where the teacher remains the expert. Teachers that have constructivist approaches to teaching ICT will use it in a way that encourages the learner becoming the expert.

Loveless (2003) states that teacher development programs do not focus on teachers' perceptions, and only focus on teacher's competence of ICT, rather than on teacher's confidence to teach with it. Teacher development programs fail to incorporate teacher's personal experiences with ICT, which would link them to a school context, to gain confidence in the use of ICT in classrooms.

Better understanding of teacher's perception of using Open Sankoré in a classroom environment could lead to a more informed approach, with a more successful implementation of teaching mapwork skills. This theme is important for the research because it creates linkages between teacher's perceptions of Open Sankoré and how the software is used in the classroom. This theme also highlights the setbacks teachers face in the South African context of incorporating ICTs within the classroom.

4.6 Conclusion

This chapter has provided an in-depth discussion of Laurillard's (2002) media forms and Conole and van Dyke's (2004) Taxonomy of ICT for the purpose of showing how teachers can use Open Sankoré to produce a specific media form, and what would be the pedagogical value of using the ICT in that particular way, in relation to the map, the world and the mind. The research also identified other themes which were taken into consideration to construct a cohesive argument within the research. The above themes that were mentioned, assisted the research in analysing data, to produce valuable and reliable findings of the pedagogical value of Open Sankoré in teaching mapwork skills, for geography departments in South Africa. The themes also highlighted important categories that give structure and coherence to the research within the analysis of data, as well as the findings of the research.

Chapter 5: Data Presentation, Interpretation and Analysis

5.1 Introduction

The research will analyse data by using the conceptual framework which was explained in Chapter 3. The conceptual framework that was discussed in Chapter 2 will support the research to gain an in depth understanding of the pedagogical value of Open Sankoré to teach mapwork skills. The conceptual framework is a combination of Innes's (2009) conception of *the map*, *the mind* and *the world*, as well as Laurillard's (2002) media forms and Conole and van Dyke's Taxonomy of ICT (See Figure 2.2). According to Innes (2009) if mapwork lessons are structured in such a way that learner have access to *the map*, *the mind* and *the world*, learners are better able to conceptualize mapwork skills and improve their *spatial competence*.

In the research Open Sankoré was categorized as in Laurillard's (2002) specific media forms, which are all dependent on how Open Sankoré is used within the lesson. Once Open Sankoré had been categorized to the specific media form, teacher's responses were analysed and affordances of Open Sankoré were identified. This would provide a conclusion on its pedagogical value to teach mapwork skills. As teachers described what they did with the technology, as well as how they taught in the lesson that would contribute to the evidence of pedagogical value within Open Sankoré. Ndlovu's (2015) table has been adjusted to incorporate *the map*, *the mind* and *the world*. All three participants of the study used the same digital tool, but the analyses will inform the research of how teachers used the software in different ways to mediate knowledge of *the map*, *the mind* and *the world*.

The data analysis consisted of three main components to answer the research questions effectively.

- a) Teachers perceptions towards teaching with Open Sankoré before teaching;
- b) Pedagogical value of teaching with Open Sankoré; and
- c) Teacher's Reflection of Open Sankoré as a teaching tool for mapwork skills after teaching.

The first part of the analyses would focus on all three participant responses to the first interview that was conducted after the training session. This would support the research in answering the first sub question of the research which was: *What are teachers' perceptions on teaching mapwork with Open Sankoré?* This would inform the research of the teacher's prior

experiences with technology, as well as providing a good sense of teacher's perceptions of using Open Sankoré to improve the teaching of mapwork skills.

The second part of the analyses would compare teacher's lessons and identify affordances of Open Sankoré that could add the pedagogical value of teaching mapwork skills. This part of the analyses would focus on answering the main research question which is: *How can Open Sankoré supports teacher's pedagogical needs to teach mapwork skills effectively in Grade 8 and 9 classrooms?* This part of the analysis would also focus on addressing the second sub-question which is: *What functionality of Open Sankoré has enhanced the teaching of mapwork in Grade 8 and 9 Social Science?*

This part of the analyses is to unpack most of the research questions to understand Open Sankoré's pedagogical value to teach mapwork skills. The focus was to unpack how the tool served as a tool of mediation from teacher to learner. The analyses would also highlight the functionality of the tool and what it offered to assist teachers in mediating mapwork concepts to learners.

The third part of the analyses focused on the reflection of Open Sankoré, as a teaching tool for mapwork skills. This would provide an understanding of the overall experience teachers had with Open Sankoré regarding teaching mapwork skills. This part of the analyses would focus on answering the following research questions: *What are teachers' perceptions on teaching mapwork with Open Sankoré?* and *What functionality of Open Sankoré has enhanced the teaching of mapwork in Grade 8 and 9 Social Science?*

This part of the analyses would inform the research on teacher's usability and adaptability of the Open Sankoré in their lessons and how it affected the overall experience of using the software to teach mapwork skills.

5.2 Descriptions of Participants

Teacher A

Teacher A has been teaching Social Science for four years. Teacher A's qualification is a post graduate certificate in education (PGCE) specializing in Life Orientation. Teacher A's qualifications do not specialize in Social Science or in geography. The teacher does not teach senior Geography or History classes and only teaches Grade 8 and 9s. This teacher prefers teaching Grade 8 classes because the teacher finds the Grade 8 topics more interesting than Grade 9. This could also stem from this teacher not being familiar with content knowledge,

because of their qualification, and because Grade 8 mapwork is easier to teach than Grade 9 mapwork.

Teacher A is apprehensive of teaching with ICT in the classroom because they do not want to be seen as vulnerable to learners. Teacher A feels that their teaching methodologies work well and there is no need to change. Teacher A attends ICT training every Friday afternoon that the school offers, but still feels intimidated to teach with ICT in the classroom.

Teacher A enjoys teaching mapwork because it is the most practical part of the Social Science curriculum. Teacher A also highlights that learners can interact more with content knowledge because it is a practical subject. There is a direct link here within the triad relationship of *spatial competence* between *the map*, *the mind* and *the world*. Learners can physically interact with the cartographic map which allows learners to internalise spatial information and accommodate knowledge into their already existing cognitive maps. Learners are then able to express their mapwork skills in the external environment. The concern here is how spatial information is internalised into learner's cognitive maps. Traditionally, the teacher mediates mapwork concepts to learners verbally in a step-by-step process.

Teacher A: *"I would say that I work in steps and they have to do step one. step two, step three."*

The methodology that the teacher uses also has links to the *spatial competence* relationship. Teacher A emphasises that learners are shown the steps which they also have to do with them. This highlights how mapwork concepts are communicated from the teacher to the learner. Through this process the teacher is scaffolding new mapwork concepts for learners. Learners use cognitive maps that are already present within their mind to link new mapwork concepts. According to Innes (2009) when learners are not able to link new mapwork concepts to already existing ones is where the learners struggle to understand mapwork skills.

The teacher also expresses that mapwork is a learner centred subject which also links to what the teacher said about the practicality of the subject. Learner agency is expressed by the interaction of the physical map.

Researcher: *Do you think it is more ... (pause) learner centred so they are on their own and they are doing their own thing?*

Teacher A: *Yes.*

Innes (2009) states that to develop *spatial competence* learners should express learner agency. This is because learners can express their understanding of mapwork concepts directly on the map, therefore learners explore mapwork knowledge on their own, which is a highly constructive approach. It is an important aspect that Teacher A recognizes that mapwork is a practical subject. This is because Teacher A recognizes that learners need to apply these concepts rather than regurgitating content knowledge. Learners who can apply mapwork skills effectively are based on the successful incorporation of *the map, the mind* and *the world* into the lesson. This will have a positive impact on developing *spatial competence* within learners.

Teacher A finds that co-ordinates are the most difficult part to teach in mapwork skills because learners have a mind-block that this particular section is difficult. Teacher A finds it difficult to eradicate learner's negative perceptions of co-ordinates because they are already present even before they teach the section.

Teacher A: *"I think always each year it's, it's co-ordinates."*

Researcher: *"Why do you think they battle.... you battle, so much teaching that?"*

Teacher A: *"I think they have a mind block against it, when they the word mapwork they have a mind block and its difficult teaching children who already have a mind block against something."*

Teacher A emphasizes that these negative perspectives that learners have about mapwork stems from primary schools, because teachers do not teach mapwork in primary schools. This is made evident by Wilmot (2015), where a review found very little evidence of mapwork being taught in primary schools.

Teacher A: *"The problem is that a lot of schools don't even have mapwork. They don't even have maps. So, the first time a child comes into class in Grade 8, it's the first time they have ever worked on a map, so ..."*

Learner's "*mental block*" contributes to the negative attitudes learners have toward mapwork skills. This "*mental block*" is due to fundamental basic mapwork skills that were not taught in primary school, and therefore learners find it difficult to comprehend when they reach Grade 8 and 9. This impacts the development of *spatial competence* negatively. According to Innes's (2009) definition of the *mind*, for learners to understand new mapwork concepts, learners must refer to the existing cognitive maps within their minds. If learners' cognitive maps are missing

fundamental knowledge bases, learners will not be able to understand more advanced mapwork concepts.

To understand the concept of co-ordinates which is using degrees, minutes and seconds to pinpoint a specific location, there is a set of knowledge bases that the learner must accommodate into their cognitive maps. The first concept that learners must be taught is *direction*. The learner must be able to distinguish between North, South, East and West. Once learners have accommodated direction, the learner is taught the difference between a horizontal line, which is called a *latitude line* and a vertical line, which is called a *longitude line*. Once learners have incorporated this knowledge base within their cognitive map, learners are taught the main lines of *latitude* and *longitude* on the earth, and what degree would they find these lines at. These skills were meant to be taught in primary school. Lastly, teachers can introduce the concept of *degrees, minutes and seconds*.

Teacher A, as well as the researcher has experienced gaps within learner's cognitive maps, because fundamental concepts have not been taught. Learners struggle to comprehend the concept of *degrees, minutes and seconds*. Figure 5.1.1 shows the ideal cognitive map that should be present within the learner's mind before they walk into a Grade 9 classroom. When learners walk into a Grade 8 Social Science classroom their cognitive map should have the main lines of the earth. The last knowledge base which is *degrees, minutes and seconds* would be added once *degrees, minutes and seconds* are taught in Grade 8.

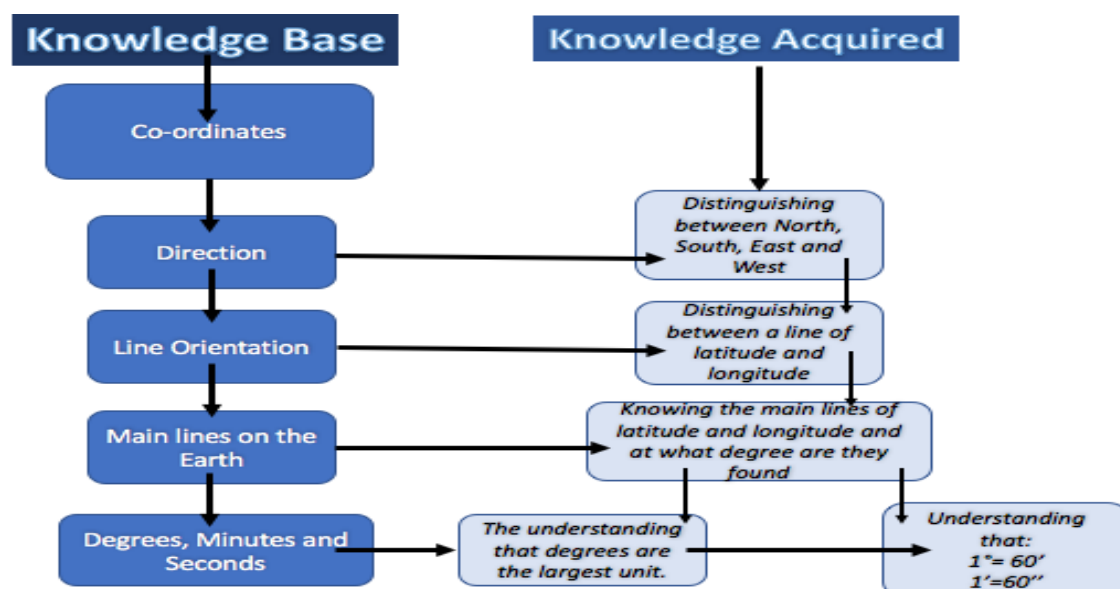


Figure 5 1: Ideal Learner's cognitive map for co-ordinatesTeacher A also mentions that learners do not find the relevance of being taught mapwork concepts such as distance, co-ordinates, gradient and direction because there are applications that do it for the learners already, such as Google maps.

Teacher A: *I think that also is a problem and as we are advancing as well, a lot of the kids don't see the point anymore of working on a map or need to know why we have to work on a map if you have a GPS for instance."*

It is evident within this statement that there continue to be fundamental knowledge gaps within learner's cognitive maps. This is because understanding these basic mapwork concepts will lead to the fundamental understanding of GIS and how GIS contributes to the real world. McAnney and Bampton (2006) in Innes (2009) "found that their students' serious misconceptions about geography and fundamental misunderstanding of the physical world was a significant barrier to GIS learning in courses" (Innes, 2009, p53). It is evident that basic mapwork skill concepts play a significant part in understanding Geographic ICTs such as GIS. A GPS is an example of the use of GIS, if learners do not understand basic mapwork concepts they will never understand the full contribution a GIS has on the real world. It is evident within Teacher A's responses that Open Sankoré has the potential to fill the fundamental knowledge bases in a learner's cognitive map and therefore Open Sankoré has the potential to be an effective digital tool to teach mapwork skills.

Teacher B

Teacher B has been teaching Social Science for six months. Teacher B also has a PGCE specializing in Life Orientation. Teacher B does not teach senior phase Geography or History classes and only teaches Grade 8 Social Science. At first Teacher B found mapwork intimidating to teach because of their lack of knowledge, as well as their inexperience in teaching mapwork skills.

Researcher: *Do you enjoy teaching map work? and explain why you say so?*

Teacher B: *At first, I found it very intimidating. It was new to me and it was very new to me.*

Researcher: *And what was the aspects that you find intimidating? So, why did you feel that it was intimidating?*

Teacher B: *So, I had to make sure that my knowledge of the content was good enough, so I could teach it. So that was intimidating because I didn't want to give the kids the wrong information. I didn't want to teach it the wrong way because if I taught it the wrong way, they*

would not be doing the right thing. So that was intimidating at first, but I think once I familiarized myself with it a bit it became a lot easier to do.

Teacher B's lack of knowledge and experience within the classroom has affected the way that the teacher has perceived mapwork. This is highlighted in Okwilagwe (2012) which states that teacher's experience and qualification has a significant effect on teacher's perceptions of teaching mapwork skills. Teacher's that had positive attitudes towards teaching mapwork "could initiate actions to propel these teachers to do or not to do constructive and creative things in the classroom" (Okwilagwe, 2012, p71). The Teacher B's lack of knowledge is a concern to the teacher because the teacher wants to equip learners with appropriate knowledge bases within the mind. If the teacher taught learners an incorrect concept this would be accommodated into the learner's cognitive map and the learner's understanding of specific mapwork concepts would be hindered.

Teacher B: *It just gets difficult when you don't know if you're doing the right thing.*

It is evident with Teacher B's responses that there is a lack of guidance within her first year of teaching. This is a major concern because teachers that have had little experience and are inadequately trained, will not know what appropriate resources to use, to encourage effective teaching pedagogy of *spatial competence*. This is exactly what the teacher is afraid of; disadvantaging learners based on their lack of knowledge.

The teacher enjoys teaching Grade 8 mapwork because the teacher can build their mapwork foundations properly and effectively. It is evident that the teacher wants to build a solid mapwork foundation with Grade 8 learners, and therefore the teacher wants to build the appropriate cognitive map within the learner's mind to improve learner's *spatial competence*.

Teacher B: *So, in terms of knowing mapwork it's like I'm starting from the beginning with them.*

It is important that the teacher recognises that learner's mapwork knowledge foundations must be solid. When learners have a solid knowledge base they can understand advanced mapwork concepts within the senior phases, such as bearing and magnetic declination. It is evident in Innes (2009) that learners inadequate mapwork foundations results in learners constantly being disadvantaged of learning higher order thinking skills within the mapwork syllabus.

Another reason why the teacher prefers Grade 8 is that the teacher has only been teaching Social Science for six months. Grade 8 mapwork skills content is easier than the Grade 9 content knowledge and therefore the teacher feels less intimidated teaching Grade 8 learners. If the teacher makes a mistake in a mapwork lesson the teacher can rectify it easily with the Grade 8s but with Grade 9s they already have prior knowledge from the previous year and therefore can make the teacher feel vulnerable in class. The teacher is not exactly comfortable with teaching mapwork skills due to his/her lack of experience and their low level of qualification. When the teacher is asked if they would be willing to teach higher grades the teacher is apprehensive at first but is willing to teach higher grades. However, the teachers do highlight that their lack of knowledge and experience would make them feel uncomfortable at first.

Researcher: *So how would you feel if you had to teach higher grades? Would you feel more intimidated? Wouldn't you do it at all?*

Teacher B: *I would do it cause it's a new challenge. Uhm I think at first, I would feel a bit intimidated by it because I have no experience with teaching any other grade SS but I ... not I wouldn't say no to it. It would be a new learning experience to me.*

Teachers knowledge of mapwork skills as well as experience affects the way mapwork is taught in the classroom. This is evident in Amosun's (2016) study which stated that teachers rarely teach mapwork skills in Nigeria. One of the main reasons is that teachers lacked understanding of mapwork concepts and therefore did not teach it.

Teacher B also finds that co-ordinates are the most difficult to teach which was the same as Teacher A. Teacher B claims that lines of latitude and longitude are abstract concepts. Learners cannot physically see lines of latitude and longitude on the earth and therefore it confuses learners.

Teacher B: *"It's hard for them to grasp the concept of which line is for longitude, what is latitude. It's... I don't know if it's a lot or I don't know if it's difficult for them, but I think it takes them a lot longer to understand it. So, the concept of longitude and latitude is so difficult for them"*

It is evident from Teacher B's responses that learners' cognitive maps do not link to the real world. If learners could see the relationship of latitude and longitude lines in the real world, the concept would not be as abstract. To improve the link between cognitive maps and the

world, teachers must consider the six Geographic classroom practices to improve teacher's geographic pedagogy (See Table 2.1). These practices encourage learners to think beyond the classroom and therefore enables them to link a concept such as latitude and longitude to the real world. Real life examples of co-ordinates could assist learners to understand co-ordinates, for example teachers could allow them to set co-ordinates of different places and show them satellite images of these places. Due to the teacher's lack of experience the teachers stated that they have not found a particular methodology that suits them. The teacher has stated that for the time being they use a question and answer method, where learners must be actively participating in lessons to understand content knowledge.

Teacher B: *"I think the main thing is I work on a question and answer system because I am also learning their questions. This helps me to learn more too. Other than that, I don't think I've done it long enough I should adapt and adopt a methodology to how I do it. I think I'm still trying to find my feet and what's the right way to do it."*

Even though Teacher B might not see the value within this methodology, it is effective. Learners are constantly engaging with the teacher about the content knowledge and therefore the teacher can identify mapwork misconceptions immediately. The teacher's methodology expresses some useful geographic practices within Table 2.1. Table 2.1 states that an effective classroom practice is to pose geographic questions, acquire geographic information, answer questions and communicate geographic information. Out of the six classroom practices the novice teacher expresses four of these practices which are based on their interview responses.

Teacher B is more willing to incorporate technology into his/her methodology than Teacher A. This is mainly because they believe that it will assist learners in understanding the content knowledge better. The teacher also attends ICT training on a weekly basis and feels comfortable using technology in the classroom.

Teacher C

Teacher C has been teaching Social Science and Geography for fourteen years. The teacher has a Bachelor of education for intermediate and secondary phases, specializing in Geography. The teacher prefers teaching Grade 9 learners rather than Grade 8 learners because the teacher can base their teaching on prior knowledge from the previous year, and therefore teaching will not be as time consuming. Technically in Grade 9, learners should have a sound cognitive map of mapwork skills, and therefore learners should accommodate new mapwork concepts easily.

Teacher C teaches Grade 10 to 12 Geography and therefore the teacher is confident with their capability of teaching mapwork skills.

Teacher C enjoys teaching mapwork skills because he/she is confident with the content knowledge and can learn about new places. The difficulties the teacher experiences when teaching mapwork is the concept of bearing. Learners do not know how to use a protractor. Bearing is not expected to be taught in the Grade 8 and 9 curricula, but the teacher experienced that learners struggle with this in the senior phases and thought of incorporating it in the junior classes. This teacher also finds it frustrating that learners leave out steps in mapwork calculations because they do not practise. The teacher also finds map interpretation difficult to teach because it requires the logic of reading off the map, as well as general knowledge of certain areas which learners lack.

***Teacher C:** “I think the learners battle to do bearing. For some reason they don't know how to use protractor. So that's basic skills from primary school that I think that they lack and then also reading off the map uhm ... Seeing what areas are cultivated and what area isn't and the reasons why they would have chosen that area.”*

Once again there is evidence that learners cognitive map has a knowledge gap when it comes to using stationery to do mapwork calculations. It is evident within this example, that there is inadequate teaching pedagogy within mapwork skills because learners have not accommodated how to use mapwork stationery into their cognitive map appropriately. Map interpretation is also difficult to teach learners because learners' cognitive maps must be well developed for learners to express effective map interpretation. Map interpretation “is considered high-level *spatial competence*” (Innes, 2009, p52). Teachers find map interpretation difficult to teach because it is one of the practical skills within mapwork, therefore learner agency must be encouraged when focusing on this particular skill. Learners also lack general knowledge of specific areas which also makes map work interpretation difficult to teach.

Teacher C expresses that learners battle with these sections such as bearings because they do not follow mapwork calculation steps. The teacher expresses that they get frustrated with learners “*laziness*”. This act of laziness may stem from learner's lack of understanding, because of under-developed cognitive maps and therefore there is a lack of motivation to practise mapwork skills. Amosun (2016) states that due to learner's lack of competence in basic map skills, map reading and interpretation, as well as mathematical skills results in learners' lack of motivation to do mapwork.

Researcher: *So why do you think they don't follow the steps?*

Teacher C: *I don't think they practise. Mapwork you have to practise. So, you can show them all the different steps and you can give them the activities and they should be asking questions if they don't understand, and technically, they should be going home and practising the same concepts and the same calculations, and I don't think they are doing that.*

Researcher: *And do you think maybe ... that's because they have ... there is a lack of map resources or...*

Teacher C: *It could be because of that but they are more than welcome to ask for a map if they want to and they do have a textbook with a map in it as well.*

The teacher also emphasises that learners do not practise mapwork skills enough, to understand concepts. To incorporate new knowledge in learners' cognitive maps there must be "sufficient time made available for learners to use all lesson elements and practise new skills" (Innes, 2009, p 242). It is evident here that Teacher C values learners' agency to understand mapwork skills. Teacher C expects learners to ask questions about concepts that they do not understand. In many South African secondary schools learners do not have access to maps or mapwork activities (Innes, 2009). At the school where the research took place, learners had access to textbooks as well as maps to take home. As a result, the lack of resources at the school was not a variable applicable to the poor understanding of mapwork skills amongst learners.

The methodology the teacher uses is a step-by-step process where learners are shown mapwork calculations step by step. This is the same as Teacher A. Learner agency is not expressed within this type of methodology and that may contribute to why the learners leave out important steps in mapwork calculations.

Teacher C: *"So what I do especially with the calculations. I'll show them an example and do everything step by step and then I show them where they get their marks. And then I'll give them one to practice on their own, but I'll do it with them so that they can see where to go and then I give them on their own."*

Once again it is evident here that Teacher C values learner agency, for learners to develop sound mapwork skills. To encourage the construction of knowledge, as well as geographic enquiry, learners must explore content knowledge on their own, to form a better understanding of knowledge. The accessibility of the cartographic map plays a very important role in the

construction of new mapwork concepts, because learners can explore the cartographic map on their own and make their own unique connections of content knowledge to the real world.

Teacher C also emphasizes that teachers that teach Social Science are under time constraints. Learners do not have time to practice mapwork skills effectively in class.

Teacher C: *“There is not a lot of activities and then also being in SS you under so much time constraint compared to the senior phase because you have to work with the content for Geography and for the History and you have to finish your content in a certain time otherwise you not going to finish so you don't allow them to have more activities to practice.*

This has many implications on trying to improve mapwork skills in the junior phases, because learners do not get enough mediation time with the teacher, to accommodate new mapwork concepts into their cognitive maps. This result in learners not adequately mastering these skills. Teacher C also highlights that there are not enough mapwork activities in the textbook to mediate knowledge. However, the humanities department in the school had made provisions and made their own activities, based on maps that all learners had access to.

Teacher C is very comfortable in incorporating technology in his/her classroom. The teacher has attended many ICT courses and is a member of the ICT committee at the school. The teacher is comfortable with incorporating digital technologies in the classroom because he/she is used to incorporating digital technologies regularly into lessons. The teacher also attends ICT training every Friday afternoon which the school offers.

5.3 Teacher’s Attitudes Towards Teaching with Open Sankoré after Training

All three teachers in the case study had a positive attitude towards teaching mapwork skills with Open Sankoré before teaching with the software. This is an important step towards implementing digital tools in the classroom because, according to Mbane (2008) and Ertmer (2010) teacher attitudes play an integral role in how ICT is used in the classroom. There were positive elements of Open Sankoré that teachers identified with that led to positive perceptions of teaching with Open Sankoré. It must be highlighted that these elements that teachers identified were based on their exposure to the software in the training sessions.

Clearer presentation

The first element that the teacher’s identified that Open Sankoré can enhance within their pedagogy is a clearer presentation of content knowledge. Teachers A, B and C thought that

Open Sankoré could help present content knowledge in a clearer and more-structured way. Teachers A, B and C also thought that Open Sankoré could assist teachers in showing learners the step-by-step processes that are needed to do mapwork calculations. Teachers A and C recognized that Open Sankoré could enhance their step-by-step methodology of teaching mapwork skills by improving the visibility of the map. Before the three participants taught with Open Sankoré, each teacher would still refer to the physical map during a mapwork lesson. All three participants found this problematic within their mapwork lessons. Teachers A, B and C found it difficult to teach with because the visual resource was so small that the learners couldn't see what the teacher was referring to on the map

Researcher: *“Do you think that Open Sankoré can assist with the ... (Open Sankoré is now the programme) can assist with a clearer presentation of content knowledge?”*

Teacher A: *“Yeah, I think so, I think it's going to be easier if the kid actually sees it on the board. it's not easy standing with a map in front saying go here ... go here ... go here. Kids miss that, so I think to have that programme ... that I think will actually help them.”*

Teacher A highlights that the software shows potential in enhancing their pedagogy by assisting learners with map orientation. Learners can see what the teacher is referring to on the map. Teacher C has the most experience out of the three participants, but still found it challenging referring to the physical map during a mapwork lesson.

Teacher C: *“I think it will be because now if the teacher is doing it on the board and showing them how to use a ruler, use the protractor to do it I think they will be able to understand it a little bit better. It's a bit difficult when you stand in front of thirty children with maps in front of them and you working on the board it's not the same but if they see the map on the board and they see you positioning your protractor then maybe they will understand a little bit better.”*

This particular teacher found potential in Open Sankoré because it is useful in assisting teachers in filling knowledge gaps in learner's cognitive maps of mapwork skills. Here, the teacher refers to Open Sankoré being used as a platform within teacher pedagogy, by physically showing learners on the software how to use a stationary aid such as a protractor or ruler to do mapwork calculations. The software shows potential in enhancing this teacher's pedagogy, because the teacher had highlighted that learners do not know how to use stationary to do mapwork calculations.

Teacher B is a novice teacher and is not fully comfortable with the content of mapwork skills but what is interesting is that the teachers still wanted to embrace the software into their pedagogy. This is because the teachers saw the value of the clearer presentation of the map while teaching mapwork skills.

Teacher B: *“Definitely, especially like when we said about uhm. co-ordinates and longitude and latitude. It will be so much easier for me to do it with them and to physically show them on the board while am doing it, how I find it, instead of having a physical big map which none of them can see because it is so small.”*

Teacher B highlighted that Open Sankoré has the potential to assist the teacher to teach co-ordinates. The software can assist the teacher in physically showing learners where a line of latitude is and where a line of longitude, is on a topographical map. The teacher emphasised that learners found co-ordinates difficult because it is an abstract concept and the software has the potential to make abstract concepts more concrete and can link it better with the *real world*.

If learners are able “to see the map detail more clearly when zooming in and out of high resolution, scanned map images makes features easier to see and the representation easier to comprehend” (Innes, 2009, p52). If there is a clearer visual representation of the map that the teacher teaches with, there will be more clarity of distance, co-ordinates, gradient and direction for learners.

This also affects the inclusivity of learners in mapwork lessons. If learners understand mapwork concepts better, they can engage in mapwork lessons. Learners that do not understand mapwork concepts do not participate or engage with teachers or learners within the lesson. There is a possibility that by teaching with Open Sankoré, there is a clearer presentation of mapwork concepts, and this may lead to more learners understanding concepts and actively participating in mapwork lessons.

It is evident within all the teacher’s responses that Open Sankoré shows potential as a narrative media form, because mapwork concepts are clearly presented. Open Sankoré may enhance the visual presentation of mapwork concepts and therefore it would make it easier for teachers to mediate knowledge to learners.

Immediate feedback

All three teachers identified that Open Sankoré has the potential to provide immediate

feedback. Teachers also identified that Open Sankoré has the potential to show learners immediately where they went wrong. According to Laurillard (2002) within the CF, immediate feedback plays an integral role in the learning process. Immediate feedback is important because “as the teacher receives feedback from the learner, he or she is able to identify misconceptions and adapt his or her descriptions to the benefit of the learner” (Ndlovu, 2015, p 109). The teacher can adapt their explanations to mediate appropriate concepts into learner’s cognitive maps.

Teachers A and B had the same opinion about Open Sankoré, being that it has the potential to show learners where they went wrong, especially in a mapwork calculation. Both teachers had explained that they show learners step by step what to do in mapwork calculation. The software can assist by showing learners at what exact step of the mapwork calculation they went wrong.

Researcher: *Do you think this software can show learners where they are going wrong immediately? So, do you think there is immediate feedback?*

Teacher A: *“I definitely think so, I think that will be a much quicker again because they see it immediately can see okay wait this is where I start. Where now if they go wrong a friend has to look for them. Once they have a friend look at what you are doing right or wrong, so you actually rely on other learners to do it. So, I think that will help a lot.”*

Teacher B: *“Definitely... because we would be doing it together and they could they will actually be able to see what I'm doing and how I am doing it.”*

Due to large class numbers, the teacher cannot physically get to every learner and make sure that they are following the right processes. The teacher uses a buddy system, where learners show their understanding of mapwork concepts to one another. Teacher C also uses this method due to large class numbers.

Teacher C: *“I like to do is, I like to put them next to a person and then when I give them an activity they work together.”*

This can cause many implications within learner’s cognitive map because learners may be expressing wrong concepts to one another and therefore mediating wrong knowledge bases into their cognitive maps. Using Open Sankoré, learners can immediately see at what part of the process they went wrong, and they do not need to rely on other learners to show them. This

also makes it easier for the teacher to express to learners the right processes to apply, when dealing with a mapwork calculation.

Teacher C: *“I think definitely with the protractor (laughs) they can see it where they would be putting it in the wrong direction. I think maybe that would help.”*

Teacher C also emphasises that Open Sankoré has the potential to show learners where they went wrong when they are using mapwork stationary. Learners can pinpoint where they incorrectly used mapwork stationary in a calculation, with the use of Open Sankoré.

Lesson pace

Teachers identified that Open Sankoré has the potential to increase the pace of mapwork lessons. Social Science teachers are always under pressure to complete the curriculum, because Social Science entails two subjects which are Geography and History. This links to immediate feedback because teachers can show learners where they are going wrong in a certain calculation on the software. This results in learners being able to immediately identify where they went wrong in a mapwork calculation. Therefore teachers can move faster through content knowledge. Teacher A emphasised that Open Sankoré can assist in increasing the pace of lessons.

Researcher: *“do you think it will ... it will be a lot faster? You know because we spend hours and hours teaching one concept in map work. Do you think it will be a little bit better it will save time?”*

Teacher A: *“Hopefully especially when it comes to co-ordinates because I feel I spend weeks on it where you suppose to maybe spend... two hours on it.”*

This is an important aspect that the teacher has identified. Open Sankoré can assist in speeding up the mediation process from the cartographic map to the mind of the learner. The researcher has experienced the pressures of the curriculum because when teaching co-ordinates the teacher spends a lot of time on concepts that should have been accommodated into the learner's cognitive map in the primary school phases. The teacher must teach concepts from primary school, as well as new knowledge from secondary phases. If the software enables teachers to explain primary school concepts in less time, Social Science teachers can spend more time on difficult concepts that is in the Grade 8 and 9 curriculum such as is spent on primary school

concepts and teachers can focus on mediating new knowledge appropriately into learner's cognitive maps.

Once again Teacher C highlights that software can be effective with assisting learners how to use mapwork equipment, as well as making this process easier for the teacher. The software may increase the pace of lessons because the teacher will show learners how to use the mapwork stationary on the projected screen and therefore learners will all be able to see how the stationary is used with one or two examples.

Teacher C: *“the teacher doesn't have to walk around to all thirty children to make sure that they are using the protractor correctly and wasting teaching time.”*

Teacher C also highlighted that due to large numbers in the classroom, the teacher would have to walk around to all thirty students to check if they were using the stationary correctly. Using Open Sankoré the teacher does not have to walk around to every single learner, which does not waste unnecessary teaching time. In this case more content can be covered within the lesson. Social Science teachers can focus on mediating difficult mapwork concepts such as bearing and co-ordinates, rather than walking around and checking that each learner's is using the protractor correctly.

It is evident that all three teachers had identified the potential of Open Sankoré, regarding immediate feedback as well as lesson pace. These affordances are linked to the interactive media form and therefore Open Sankoré has the potential of acting within the interactive media form, based on teacher's responses.

Collaborative

Teachers B and C found that Open Sankoré had the potential to be collaborative. It is important that a digital tool encourages collaboration between teachers and learners. Collaboration plays an important role in the learning process. It encourages learners to explore knowledge and develop higher-order thinking skills.

Teacher B highlighted that for the software to become collaborative, learners must use the software. Even though the teacher recognized that the software can be collaborative based on learners doing calculations with the teacher, and therefore the teacher and the learners are working together so learners can understand content knowledge better.

Teacher B: *“I think it can become more collaborative if the kids have the software too. For now, it’s purely based on what I am doing.”*

Because learners do not have access to laptops or tablets at the school, the learners are not able to use the software yet. The teacher believes that, for the software to be collaborative, learner agency must be expressed, for the learner to explore content knowledge. Therefore the teacher does not perceive the software to be as collaborative as it could be.

Teacher C had an interesting view of the software being collaborative. The teacher stated that the software does have the potential to be collaborative, but the teachers use of the software must be at a high level of competency to encourage collaboration. “Teaching expertise revolves around understanding learning and how to mediate it” (Ndlovu, 2015, p6). Therefore, teachers must have the knowledge to use the ICT to accomplish certain teaching and learning goals. If a teacher wants to encourage collaboration in their practice, the teacher must know how to use Open Sankoré in such a way that it expresses collaboration within lessons.

Teacher C: *“I definitely think it could work. Uhm the teacher would have to be a little bit more savvy on the computer to get the content across, but I think yes it's, it can work.”*

Teacher C highlights that teacher training is important to incorporate a digital tool effectively in the classroom.

Teacher A decided not to comment on the collaboration of the software because he/she wanted to teach with the software first before concluding, therefore there were no elements within the training session that encouraged the teacher to perceive that the software could encourage collaboration within mapwork lessons. Collaboration is an affordance within the communicative media form. Open Sankoré did show potential to be used as a communicative media form, especially by Teachers B and C.

Diversity

Two participants also identified that mapwork can be taught in different ways by simply using the software. Diversity is an important affordance to consider when adapting ICTs. The digital tool should be able to “source, store and manipulate content, to form “representations amongst other capabilities, to accomplish specific educational goals” (Ndlovu, 2015, p15). For teachers to consider a tool of value within their pedagogy, the digital tool must support the different teacher needs as well as learners needs. What appealed the most to participants especially

Teacher A, was that, by using the program, Teacher A was able to use different maps on the software.

Teacher A: *“You are testing a child on the same map by giving him the same map over and over and over again. So, I think this actually opens up lots more creativity for the teachers and diversity to use different types of maps, different types of tools to actually teach them instead of one map, one way.”*

Different maps could be used to teach the same mapwork concepts instead of testing learners on the same map all the time. This would assist teachers in linking learners cognitive map to real world, by showing learners different maps of different places around the world. This also links to the accessibility of the cartographic map in that using the software, teachers and learners have constant access to different maps.

Teacher B also found that this functionality of the software was useful because the teacher was able to adjust the pace of the lesson, according to the learner’s educational needs. The teacher also emphasised that they were able to teach concepts in various ways, and therefore there is non-linearity expressed when teaching with the software.

Teacher B: *“I think gives you a lot of different ways to do map work and not just a set way also ... uhm I can adjust to the different classes that I have so the way I use it for one class won't be the same way they do, or we do it. Because different learners take in information in a different way.”*

The teacher can use various amounts of tools on the software to teach one concept. For instance, the teacher can use a highlighter, pen or text box to mark off certain co-ordinates. (Examples will be shown in Chapter 5). The teacher can apply the same mapwork concepts to different maps around the world, which makes it non-linear.

Teacher C did not perceive the software to be diverse at first. The teacher stated that not much of their methodology would change once they had implemented the software into their pedagogy.

Teacher C: *“I think any teacher can incorporate into a methodology like for me I show them how to do it step by step, so I would still show them that using the software how to do it step by step.”*

The teacher thought that the software would be easily adaptable to their teaching methodology. This could be a positive or a negative factor for adapting Open Sankoré to teach mapwork skills. If the teacher perceived that the digital tool would be easily adaptable into their teaching methodology it was more likely that the teacher would be willing to adapt it. On the other hand, it was evident within the teacher's response that the teacher perceived that elements of their pedagogy would be enhanced but nothing much would change, because the teacher would still be doing the same thing as if the technology was not there. It seemed that Teacher C did not see the difference the software could make to teaching and learning yet. Diversity is an affordance that stems from the adaptive media form. Open Sankoré shows evidence that it does have the potential of being used as an adaptive media form, especially by Teacher B.

5.4 The Importance of Teacher's Attitudes and Perceptions in Incorporating Digital Tools

It was evident that all three teacher's impressions of Open Sankoré, after training, were positive about using Open Sankoré in their pedagogy. It is vital that teachers have a positive attitude towards integrating technology into their pedagogy because it would affect the way the technology would be used in the classroom. In Ertmer (2010) a study was conducted where experienced teacher's negative attitudes towards incorporating technology into their classroom affected novice teachers' use of technology in the classroom. As a result, novice teachers hardly used ICT within their classroom, because they also developed a negative attitude towards teaching with technology.

The main reason that teachers in the research had a positive attitude towards the software was that teachers could identify elements within their pedagogy that Open Sankoré could enhance. Teachers were able to identify the relevance of using the digital tool to improve teaching and learning of mapwork skills. For successful adaption of ICT in teacher's pedagogy the teacher must identify the value and relevance of using a specific digital tool. If the teacher does not see value in adapting a digital tool within their pedagogy it is less likely that the teacher will use the digital tool in their teaching. The value and relevance of the digital tool also effects teacher's perceptions and attitudes towards incorporating a digital tool within their pedagogy. Table 5.3.1 represents what media forms teachers perceived Open Sankoré to be, to enhance the teaching and learning process within the training session.

Table 5 1: Media forms teacher's perceived Open Sankoré to be after the training session

Media form	Teacher A	Teacher B	Teacher C
Narrative	✓	✓	✓
Interactive	✓	✓	✓
Communicative	✓	✓	✓
Adaptive	X	✓	X
Productive	X	X	X

5.5 Lesson Analyses

In this section of the analyses the participant's lessons were analysed through transcripts, as well as field notes. This would enable the research to determine the pedagogical value of Open Sankoré to teach mapwork skills. All lessons were set up as revision lessons since the content knowledge had been already taught in the first term, and it would be too risky to jeopardize learners' marks in Social Science to understand the pedagogical value of a new digital tool. Another factor that contributed to this was that the Ethics committee did not clear the research in January 2017, therefore lessons were based on revision. All three participants would be analysed through each media form. This would also inform the research as to how diverse the digital tool is in teaching mapwork skills.

Teacher A: Lesson analysis

Lessons observed: Four

Topics: Grade 8 and 9 Scale, Grade 8 and 9 Co-ordinates

Time: Forty minutes each

The teacher had a positive perspective of Open Sankoré before teaching. Each of the four lessons were structured similarly, because they were taught by the same teacher and the teacher did not veer far from the suggested lesson structure, that was given to each teacher at the training session (see Appendix C for further detail). In all four lessons, content knowledge was taught eight weeks prior to these lessons. Learners had become unfamiliar with content

knowledge therefore the teacher introduced the topic in great depth and spent seven to ten minutes on each lesson, introducing the topics.

Open Sankoré as a narrative media form

In all four lesson's there was a substantial amount of evidence that show that Teacher A was using Open Sankoré as a Narrative media form. The discursive phase is a learning activity that encourages communication between the teacher and the learner, to describe and re-describe theories, ideas and concepts of content knowledge (Ndlovu, 2015). This learning process is found within the Narrative, Interactive and Communicative media forms. In this case Teacher A used the discursive learning activities to explain concepts such as co-ordinates, scale and gradient. Teacher A uses the narrative media form in the introduction of their lessons. It was evident within the Grade 9 co-ordinates that Open Sankoré was used as a Narrative media form:

Grade 9 co-ordinate lesson

Teacher A: Alright so let's quickly have a look I want you to open your map and follow me on the board now. Let's have a look at our lines of latitude and we looked at our lines of longitude before we look at anything else. (04:08 teacher is showing learners what these lines look like on the map with the software). So, if we look at this ... (long pause) and we go up everyone go to block A1. Everyone focus on the map and have a look at A1 so what we are looking for now are lines of latitude.

In this example there is not much communication between the teacher and the learners. The teacher is using Open Sankoré to explain concepts. The teacher is encouraging learners to look on the board at the map that is on Open Sankoré. The teacher is emphasizing the presentation of content knowledge. Here, the teacher is using Open Sankoré to show learners what lines of latitude and longitude look like on the topographical map. The teacher used the zoom-in function for learners to see the co-ordinates in the left-hand corner of the map. The teacher circles each degree using the highlighter on the software to show learners which degrees belong to which line. The teacher then re-iterates the concept of latitude and longitude by drawing a red straight horizontal line next to the degree, so learners can see why that degree would be considered a South co-ordinate. The teacher does the same with the line of longitude. Teacher A also used Open Sankoré in the same way in the Grade 8 co-ordinate lesson within the introduction.

Grade 8 co-ordinate lesson

Teacher A: So, I want you to have a look here Grade 8s (03:18 showing learning on Open Sankoré) if we look at the at these lines over here and this is what normally confuses you and if I have to ask you show me these lines of latitude. This is where the problem comes in. So, we know that lines of latitude indicate either a northerly or southerly direction isn't it? So, if I look at lines of latitude I know they run horizontally. This is where the problem comes in you guys have a look and what do you say. Here it is... (teacher showing a line of longitude on the software).

Here, the teacher used the narrative media form to present the concept of lines of latitude and longitude. Based on learners' feedback the teacher found that learners had not understood the concept and used the whiteboard to draw the world with the main lines of latitude and longitude. Therefore, the teacher used ICT, as well as a non- digital resource, to explain content knowledge. The teacher still found that the learners were not understanding the concepts and the teacher then switched into another media form, which will be explained later.

It was evident within the Grade 9 co-ordinates lesson that due to the teacher drawing a line on top of the map grid the learners could see the lines of latitude and longitude more clearly. Figure 5.4. shows how Open Sankoré provided teachers and learners with a platform to improve the visibility of the map.

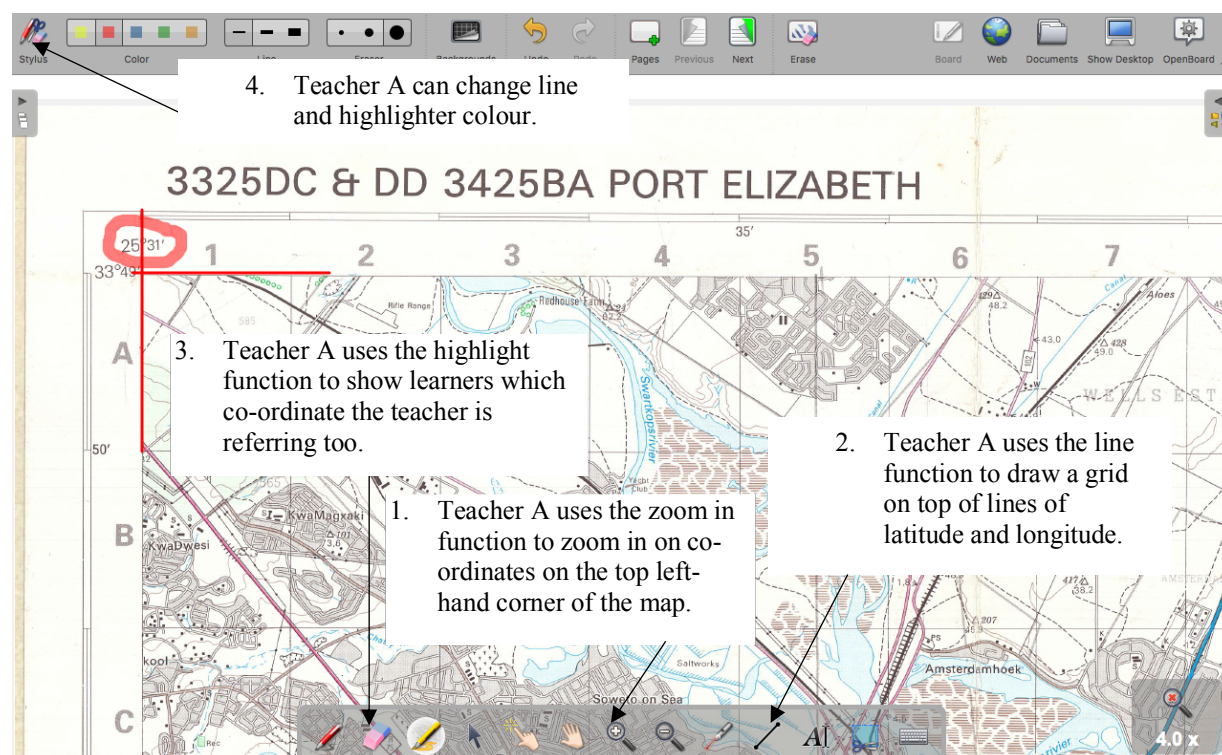


Figure 5.4.1: The use of the Zoom function, Highlighter and Pen to teach Grade 9 co-ordinates

In the two co-ordinate lessons Teacher A relied heavily on the narrative media form to introduce concepts to learners. It was also evident within the scale lessons that the teacher used narrative media forms to introduce scale on the map. The narrative media form was also evident in co-ordinate lessons to show learners how to use lines of latitude and longitude in relation to degrees, minutes and seconds. The teacher also made use of the narrative media form in the Grade 9 co-ordinate lesson to show learners how to divide the block up into seconds. The method is also utilized in the Grade 8 lesson to show learners how minutes increased on the map.

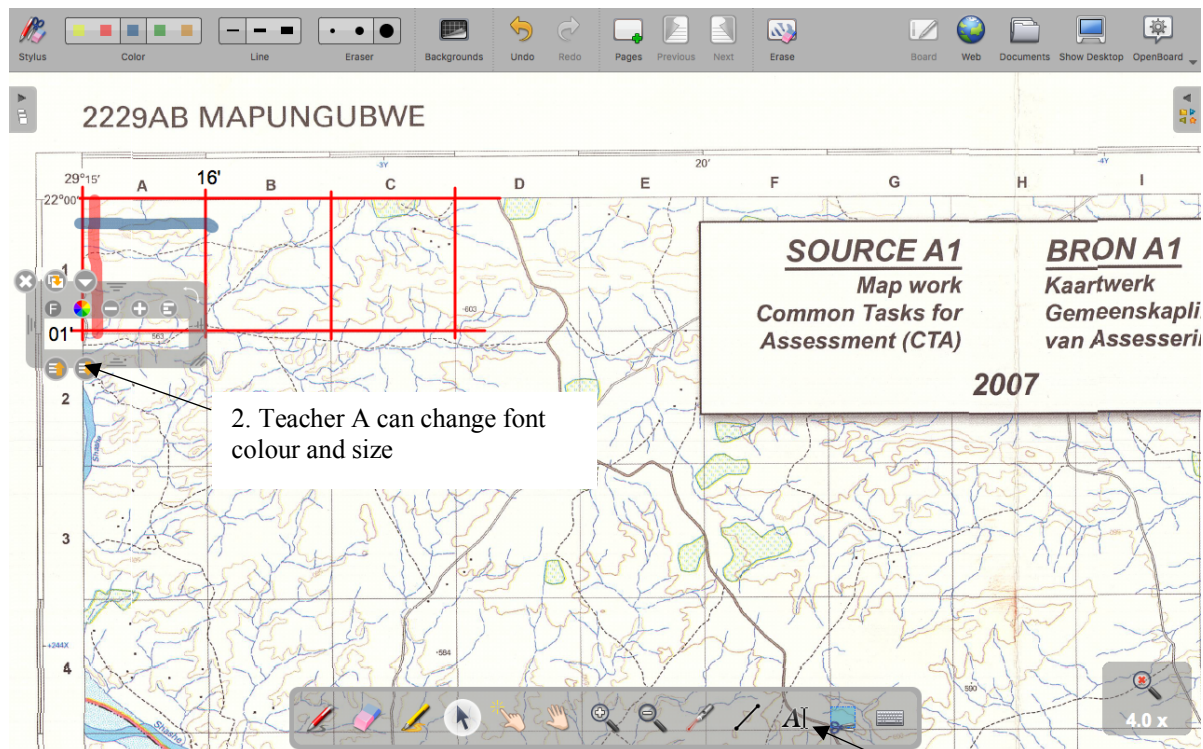
Grade 8 co-ordinate lesson

Teacher A: “60. Alright in other words, I have to go, go, go, go, all the way there to get to the next minute. Then I must go all the way there to get to the next minutes.” **(15:37 Showing learners how minutes are separated on the map with the software)**. I have to go all the way down 16 minutes before I can get to the next degree. So, if I am at 22 degrees and 0 minutes. How many minutes do I have to go to get to the next degree?

Learners: 60

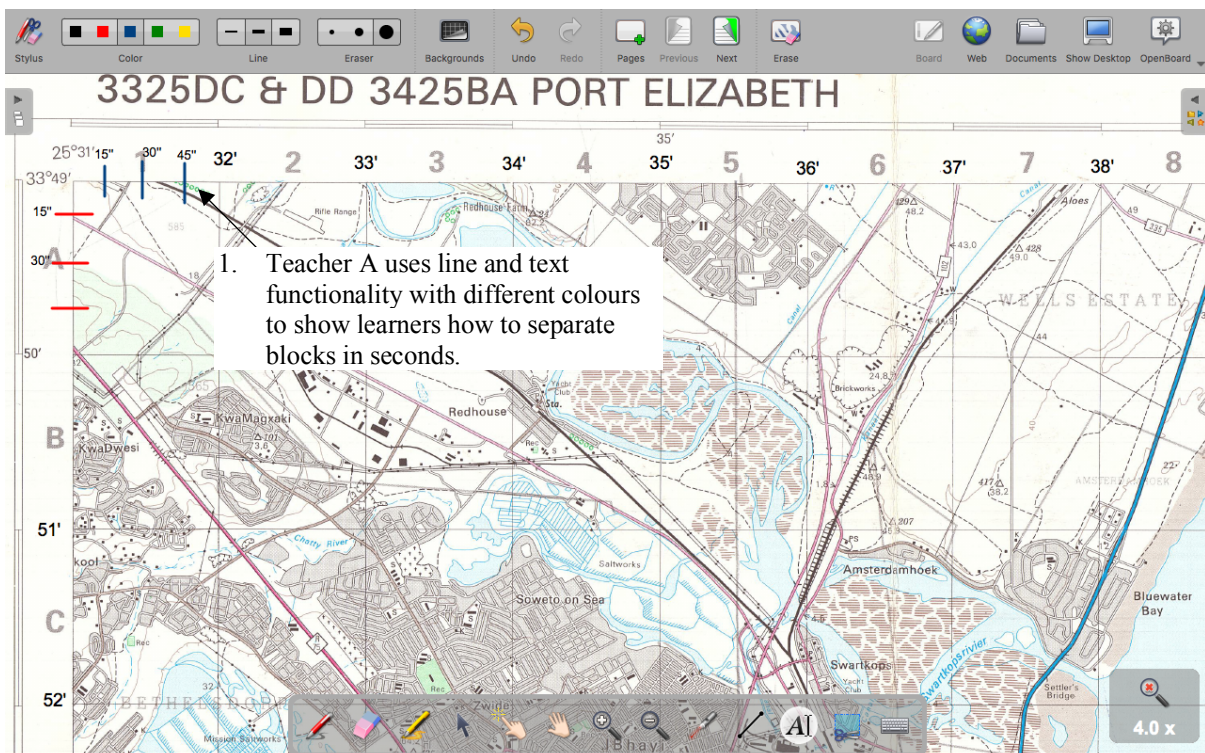
Teacher A: 60 minutes. In other words, this whole block over here. This whole block here will indicate 1 minute. **(Indicating with the pointer)**. This whole block here will indicate a second minute because every block to you is worth one minute in other words, if we start here and we say 22 degrees and 0 minutes **(Points at 22 degrees and 0 minutes with the software)** that means I must walk, walk, walk, walk, walk, to get to the next minute in other words once I get here to this line over there. **(16:34 showing the line on the software)**. I can now write 01 minutes. **(long pause)**.

The teacher used the pointer, which was in the program to show learners how lines of latitude and longitude are used on a map. Before the teacher did this, there was an in-depth explanation of degrees and minutes and therefore the teacher asked for feedback; but it was not in relation to the map yet. The teacher made use of the line and the highlighter function to show learners the differences between lines of latitude and longitude. There is evidence that the software restructures how content knowledge is presented to learners. In this example there is evidence that pedagogy is enhanced because the teacher can physically show learners why there is a grid on the topographical map; Whereas before, the teacher had to draw the grid on the board.



Using line, highlighter and textbox to teach Grade 8 Co-ordinates on Open Sankoré

1. Teacher uses the textbox function to show how to work out co-ordinates.



Using line and text box to teach Grade 9 co-ordinates on Open Sankoré

The same that was done in Figure 5.4.1 was done here. The teacher made use of the text box to fill in minutes for only one part of the map for learners to visualize how to work out minutes on a map. The teacher used the narrative media form to show learners the differences between a ratio scale and a line scale on the map. The teacher used the zoom in function to show learners where to find the line scale and a ratio scale on the map. The teacher showed learners how to do line scale on the map. There was no engagement from learners and the teacher was using it as a presentation tool.

Grade 8 Scale lesson

Teacher A: *How many centimetres will represent that 1000 meters and that is what a scale is, it is showing me how much reality has shrunk. Now remember my bottom scale and my ratio scale won't be exactly the same. Why? because the ratio scale is a more accurate version then the line scale. If I take my ruler over here, over here it indicates to me that this part equals 1000 meters. So, if I want to measure that I take my ruler and put it on the 0 up until the 1.*

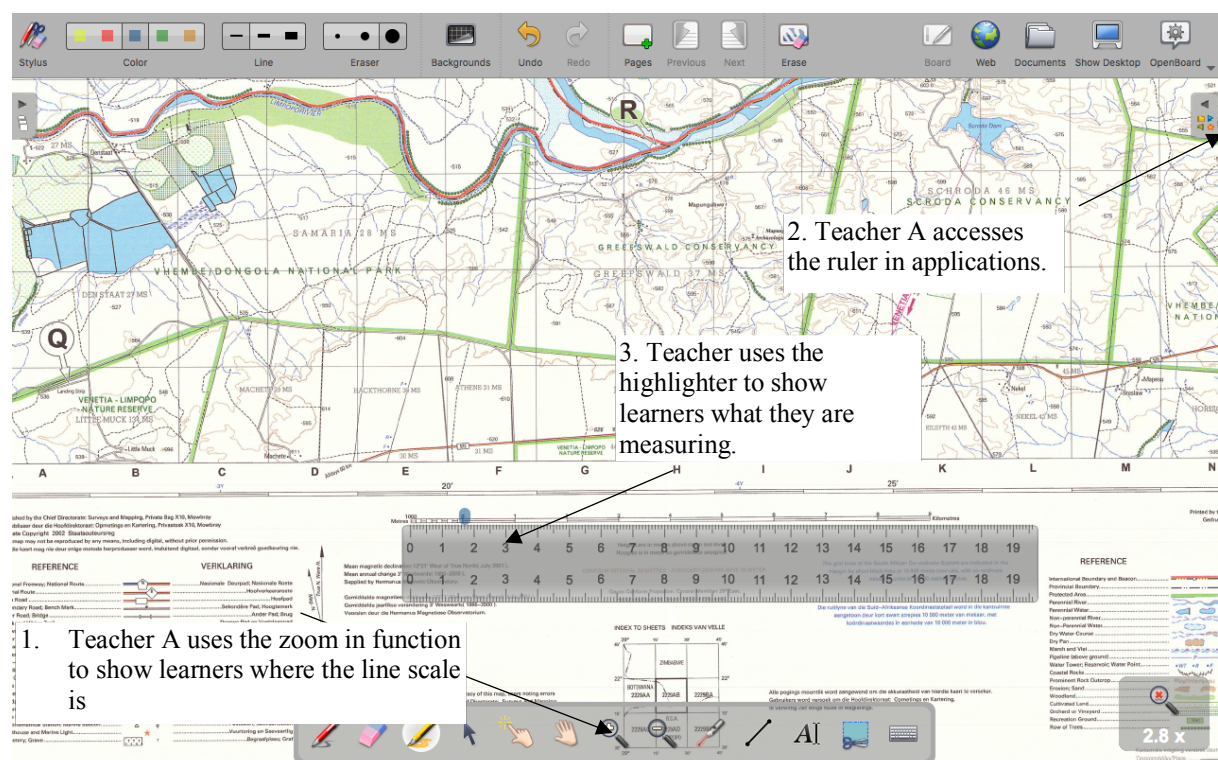


Figure 5.4.2: Using electronic stationary and highlighter to teach line scale on Open Sankoré

Figure 5.4.4 showed how the teacher used Open Sankoré as a narrative media form. Once again, the teacher made use of the highlighter to indicate to learners on the map that this was where they would find the specific scales on the map. The teacher also used this method in the Grade 9 scale lesson to introduce the topic. Teacher A also used this method to introduce

gradient but here the teacher used blended learning. Teacher A made use of the whiteboard for learners to have a visual representation of the gradient formula.

Grade 9 Scale lesson

Teacher A: *Gradient equals height over distance. And do you agree with me whenever I have something like this isn't that the same as a ratio? This is a ratio isn't it? So, it is like that isn't it (33:45. The teacher is using the whiteboard to write the ratio and a fraction. Using blended learning here). Right, it's a ratio now we know when we do ratios we did it when we did scale can I ever have two different units? Can I ever compare an apple to a pear?*

The teacher also used this narrative of media form to orientate learners on the map. Teacher A showed learners on the map where exactly they should be measuring from. This methodology was used in all four lessons where the teacher zoomed in on the place that the learners should be measuring from.

Teacher A: *So, everyone go to block A8. Give me two seconds while I zoom out then (27:21 Software sometimes takes long to zoom out and zoom in on the map). Go to block A8 and find trig. beacon 102 then go to block A9 and I want you to find trig. beacon 427 got it right. So, give me two seconds to get there and you going to have a look at ...*

Above is an example of how teacher used this method within the Grade 9 scale lesson. This method also exposed learners to the topographical maps conventional signs. Therefore, when the teacher zoomed into a particular place the learners could see what particular conventional sign the teacher mentioned looked like. This would improve learners' *spatial competence* by improving how reality was symbolized on a map.

Open Sankoré as an interactive media form

It was evident through the observation of lessons that Teacher A predominately used Open Sankoré as an interactive media form. This media form encouraged the discursive learning process but required more engagement from learners. Teachers relied on learner's immediate feedback to shape or customize the mediation, based on the learner's answers. In this media form there was evidence of learners actively engaging with the map on Open Sankoré.

Grade 8 Scale Lesson

Teacher A: *Now what I want you to do you now take out your ruler and we now going to place our ruler onto my first line so spot height 582 so we take it and we place it on that line that we have drawn. Okay ... you then join those two lines and what do you get?*

Learners: *Mumble ... 5,5 cm.*

Teacher A: *You should get around about 5,5 who did not get that? What did you get?*

Learner: *5,6.*

Teacher A: *Remember you are going to get a 0,2 centimetre leeway so what would work?*

Learners: *5,5 and 5,6.*

Teacher A: *5,5 and 5,6 so who did not get that? Measure again please. So, from the dot so where you drew your which should be from that dot up until the dot at 559 at spot height 549. (Long pause).*

Learners: *5,5.*

Teacher A: *with that? Which one should you rather be measuring with because you have no commas here take your millimetres and can you see you get a clearer indication? 5,5. Alright makes sense?*

It is evident here that learners had to physically engage with the map to answer the teacher's question. While the teacher was adding the ruler to the map on Open Sankoré the learners had to do the same on their physical map. The teacher guided the lesson based on immediate feedback from learners. In this example the teacher had picked up that learners miscalculated scale and he/she made learners aware of what they had done wrong. The teacher then re-structured the calculation by asking learners to write their measurement on the line (this is not normally taught in a scale calculation). The teacher did this to avoid this miscalculation of scale. In Figure 5.4.4 is the example the teacher used to explain line scale. Due to the scanning of the maps the scale was 0,3-0,4 centimetres off, which learners and teachers should be made aware of. The Figure 5.4.5 below shows an example of how the teacher used Open Sankoré to teach a distance calculation.

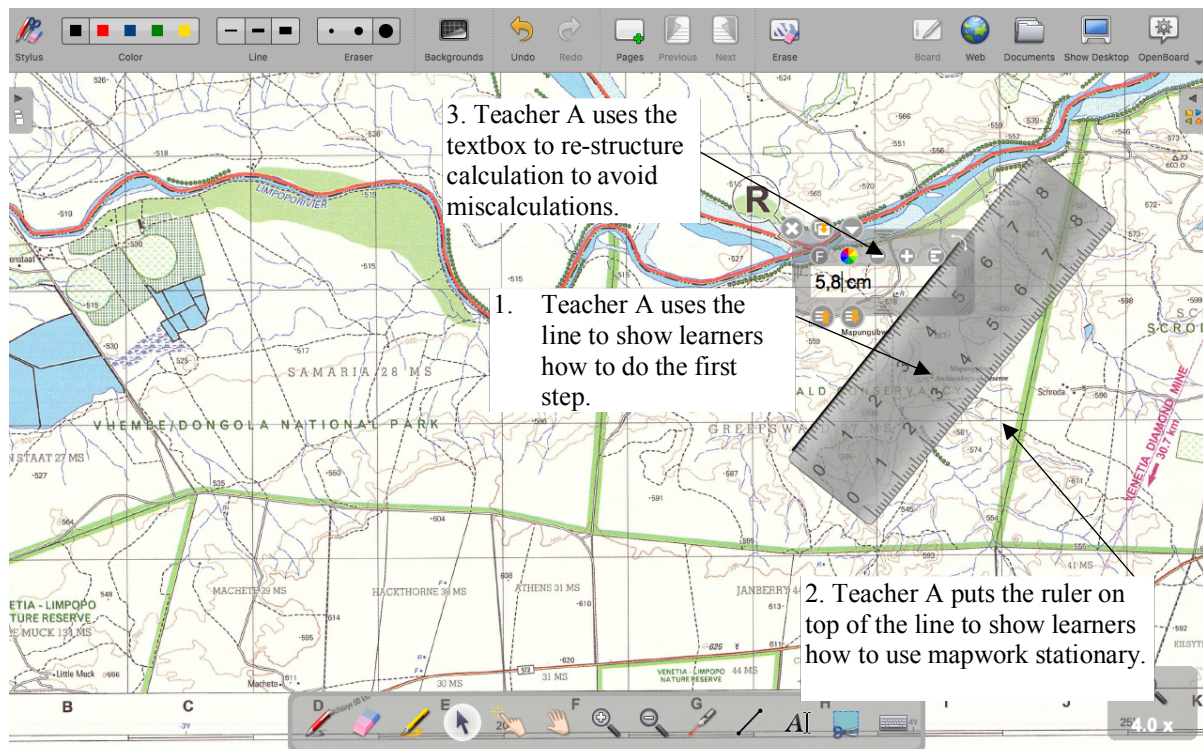


Figure 5.4.3: Using electronic stationary, line and textbox to teach Grade 8 Distance on Open Sankoré

Teacher A also used interactive media to teach Grade 8 and 9 co-ordinates. She asked learners to assist here in filling in all the minutes on the map. In the Grade 9 lesson the teacher asked learners how to divide a block up into seconds (see Figure 5.4.3). Even though the figure represented what the teacher did first without any interaction, the teacher used another block and guided learners by dividing the block up into seconds. The bold numbers that are seen on the side and on top of the map the teacher filled in with the help of the learners. This was interactive because learners were engaging directly with the map on Open Sankoré and the teacher was relying on answers from learners.

Grade 9 co-ordinate lesson

Teacher A: *And in between 25 degrees and 31 minutes 32 minutes what would I have?*

Learners: *60 seconds.*

Teacher A: *Now that is not given to you and you need to do it yourself and you need to be very accurate. So, what you will do you will take your ruler and you will go and measure. You will take each block and you will divide ... let's start with latitude lets divide the 49 minutes (15:09*

the teacher shows learners how to divide a block up into seconds on the software). And half of that will be what?

Learner: 30.

Teacher A: 30 seconds between 49 minutes and 0 seconds and 30 seconds what will I have?

Learners: 15 seconds.

Teacher A: 15 seconds between 30 seconds and the next minute what will I have?

The teacher relied on constant feedback from learners while learners were engaging with the map on Open Sankoré. Learners once again, had to provide feedback to the teacher for the teacher to make sure that learners understood the mapwork concepts at hand. It was evident within Teacher A's mapwork lessons that when the wrong feedback was given, the teacher switched media forms or used blended learning to re-iterate concepts. At first when the teacher started introducing co-ordinates with narrative media forms and asked learners a few questions about lines of latitude and longitude (these questions did not relate to the map), the teacher realized that learners did not understand the concept. The teacher then switched to interactive media, where learners engaged with the map on Open Sankoré. The teacher also used the whiteboard to re-iterate concepts.

Grade 8 co-ordinates

Teacher A: *What happens to it? It runs down. Do you see the difference? The next one runs down. Next one will run? (Teacher is showing this to learners on the software).*

Learner: Down.

Teacher A: *If I look at this line, it has two sides doesn't it?*

Learners: Yes mam.

Teacher A: *What direction would this be of the line?*

Learners: East and West.

Teacher A: *This side?*

Learners: East.

Teacher A: *West. What direction would be on this side of the line?*

Learners: *West.*

The teacher also re-iterated concepts in the Grade 9 scale lesson where a learner mixed up the gradient formula. Here, the software was used to teach distance, but the gradient formula was then calculated by the teacher on the whiteboard. The teacher constantly asked for feedback from the learners.

Grade 9 co-ordinate lesson

Teacher A: *So, we've done height so don't worry about distance. Alright so what have I just got there? I've got my height. Does everyone know how I got that height? What would have been the issue if you had taken 407 and 102. What mistake would you have made? (30:44 Teacher is highlighting common mistakes learners make when doing gradient).*

Learner: *Swopping it around.*

Teacher A: *No, not swapping them around what mistake would have made here if you used 102 and 427 to subtract. You are just subtracting the numbers from each other those numbers are only for us to be able to recognize the trig. beacons. So, you take the height which is at the bottom of your triangle got it.*

Learner: *Yes mam.*

Here the teacher was highlighting where learners go wrong when they do a gradient question. Once again, the teacher made learners aware of common mistakes that were made during a gradient calculation. The teacher re-iterated the concept by doing the distance calculation on the software and then moved across to the whiteboard to do the rest of the gradient formula. The teacher showed the learners the correct number that they should be using in the trig beacon because a trig beacon has two numbers; one that states the beacon number and the other that states the altitude. To do a gradient formula, the learners needed to identify the altitude and not the beacon number. Therefore, the learners were engaging with the map on the software to identify the altitude on the trig beacon, with the guidance of the teacher.

Open Sankoré as a collaborative media form

Although the software was used as a presentation tool to show learners how to do a mapwork calculation such as scale, there was also evidence within Teacher A's observations that Open Sankoré also encouraged the Communicative phase of the CF. The lesson was collaborative because the teacher and the learner were working together to unpack content knowledge. As

learners got more confident, the teacher switched roles and asked learners what should be done to get the answer, which allowed learners to communicate content knowledge to the teacher. Towards the end of the lessons, the teacher allowed learners to do case study activities in groups and learners had to do the mapwork calculations on the whiteboard. This is where learner agency is expressed, and it is an important part of understanding mapwork skills. The way that the teacher structured their pedagogy has endorsed Open Sankoré to become a collaborative ICT tool. The example below shows the teacher encouraging learner agency.

Grade 9 Scale lesson

Teacher A: *Alright, so you draw your trig. beacon you draw your line what do we do now?*

Learner: *You write the answer.*

Teacher A: *How? we don't have a ruler yet. Yes ...*

Learner: *We draw a line from the symbols.*

Teacher A: *Yes, we draw a line from the symbol if there is no symbol we use the letter. If there is a symbol you do it from the symbol okay. So now we take our ruler and we going to measure it nothing changes now. (32:08 the teacher is using the ruler on the software to show learners how to measure). From the beginning there of my trig. beacon and can now go and measure to the next and it is going to give me what?*

Learner: *2,3 cm.*

Teacher A: *2,3 cm does everyone agree?*

Learners: *Yes mam.*

Here, the teacher was using the software itself and modelling the software, to encourage communication between the teacher and the learners, to solve a distance calculation to then solve a gradient calculation. Therefore, a discussion was clearly formed by the teacher and learner. It must be highlighted that the ICT was not encouraging this, but the way the teacher was using the ICT is. Another example of the teacher using Open Sankoré as a communicative tool was the way she encouraged conversations between learners. The teacher encouraged learners to work in groups on a case study where learners still needed to engage with the map on the software. This was evident in the Grade 9 co-ordinate lessons as well as the Grade 8 scale and co-ordinate lessons.

Teacher A: *Okay very quickly Grade 8s very, very quickly in groups of two work together. I want you to do, this case study for me. So, an aeroplane needs to make an emergency landing because it has run out of fuel. You are at the control centre and you need to give places on the map where the pilot can land. So, tell the pilot where to go. To get to landing strip in D7. Work together quickly, two minutes, give me the coordinates. (Long pause, waiting for learners to find out the coordinates). Once you find it, write down your coordinates you can't just tell me I found it.*

Learners: *We are done mam.*

Teacher A: *On the board please. Alright quiet now thank you. Let's have a look if you weren't too hasty.*

The teacher had placed the map on the software that the learners should be referring to on their physical maps. Even though learners were engaged with their physical maps, learners still referred to the software to get another perspective. Learners were not collaborating with the teacher this time, but they were working with other learners to get specific answers.

Open Sankoré as an adaptive media form

There were not many examples within the four lessons of an adaptive media form. There was some evidence within lessons that showed that the software could be adaptive to teacher pedagogy but not necessarily adaptive to learner's feedback. In three out of the four lessons the teacher was able to run the software as well as access other documents such as Google Docs to access case studies that were based on the map.

Teacher A: *What I want you to do for me now guys, you now going to do a case study. I want you to work in groups of four. So, you can swop your desks around and work together it doesn't really matter guys if two, three, four doesn't really matter. Quickly get into your groups erase all your pencil marks. Okay, alright the reason why I want you to work in groups, thank you. What you going to do now guys is that I am going to give you one area and you need to find the other area. It's not to say that you all have to work together - once you can all sit and work on your maps and help one another, if one person can't find the location. Make sense ...*

Here, the teacher had accessed a Google doc while the teacher was still running the software. This provides evidence that the software showed diversity where the teacher could access other documents to enhance learning. Another example of the software's adaptability is that while the teacher was teaching scale to the Grade 9 learners the teacher switched into an orthophoto to show learners the scale on the orthophoto. The teacher explained to the learners that the ratio was different and therefore they would multiply by a different number.

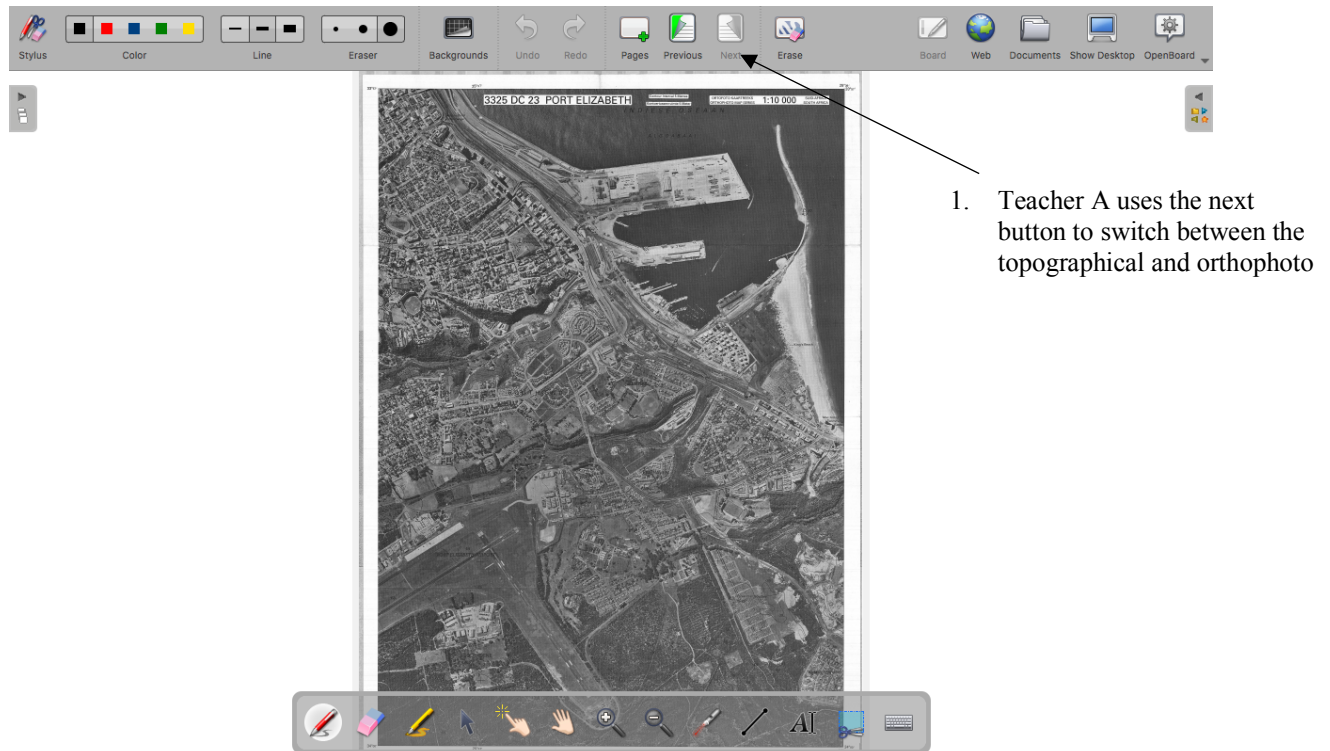


Figure 5.4.4: Switching between the Topographical and Orthophoto Map on Open Sankoré

Summary of Teacher A: Lesson analyses

Table 5.3.1: Teacher A's use of Open Sankoré expressed as Laurillard (2002) Media Forms

<i>Media forms</i>	<i>Affordance</i> →	<i>Evidence</i> →	<i>What pedagogical value does Open Sankoré add to mapwork skills? (the map, the mind, the world)</i>
Narrative	Non-linear: Display of map on Open Sankoré	Multimodality: Map and written text were used in the lessons.	<i>The map:</i> Presentation of a Topographical/Orthophoto is clearer on Open Sankoré. <i>The mind:</i> Teacher was able to show what scale is and what lines of Latitude and Longitude are, by showing learners where this is on the topographical map as well as different types of scale that were on the map. <i>The world:</i> Learners are exposed to the digital tool which is in the external environment.
Interactive	Immediacy: There is immediate feedback from learners because the teacher is constantly asking questions.	Immediate Feedback: There is verbal feedback of content knowledge from learners to teacher based on the topographical map which is displayed on Open Sankoré during the lesson.	Re-description of concepts: <i>The map:</i> Learners are shown correct mapwork processes on the software. <i>The mind:</i> Misconceptions of mapwork are amended by the teacher verbally. <i>The world:</i> Communication between teacher and learner in the external environment.

Communicative	Collaboration: Teacher and learner work together in a step-by-step process with the software to show learners how to do scale and co-ordinates.	Discussion: Class/ Group: Introduces topics by encouraging communication between the teacher and the learner. Later in the lessons the teacher enables learners to discuss content knowledge as a group.	Re-description of concepts: <i>The map:</i> Learners engage with the Map on Open Sankoré as well as their physical map. <i>The mind:</i> Learners internalised mapwork concepts such as scale, co-ordinates, gradient and discuss these concepts with teachers and learners. <i>The world:</i> Communication between teachers or learners.
Adaptive	Diversity ▪ Switch between map ▪ Able to access different documents in the software access	Reproduction: Experiment/ Role play: None	Concretising Theory: Practice None
Productive	Articulation None	Production: Animation/ Model None	Knowledge construction None

Links between map, the mind and the world in Teacher's A lessons

Innes (2009) stated that to develop *spatial competence*, the teacher had to make sure when teaching a new mapwork concept, that *the map*, *the mind (cognitive map)* and *the real world* were linked together. There are many examples within the transcripts where the teacher relates to the real world. In Teacher A's co-ordinate lesson, they introduced co-ordinates by mentioning a GPS, which relates to the *real world*. Teacher A also mentioned how the map is related to the Equator, as well as the Greenwich Meridian. This linked new knowledge, being co-ordinates, to existing knowledge within the learner's cognitive map. While Teacher A was introducing gradient, the teacher mentioned a mountain which related to the real world. The teacher also made learners think about the size of areas of the map in relation to the real world. These links between the map, the mind and the real world are generally made in the

introduction of the four lessons. The teacher's mere use of teaching tools such as using Open Sankoré and the whiteboard enabled learners to engage with their external environment. It was evident towards the end of all four lessons that learners were more than able to do mapwork calculations such as co-ordinates, distance and gradient on their own.

Teacher B: Lesson Analysis

Lessons observed: Two

Topics: Grade 8 Scale and Co-ordinates

Time: Forty minutes each

Teacher B is a novice teacher and the teacher had a positive attitude towards teaching with the software. Two Grade 8 lessons were observed, and content knowledge was taught eight weeks prior to these lessons. Learners had become unfamiliar with content knowledge, but unlike Teacher A, Teacher B did not spend much time on introducing topics but focused on practising mapwork calculations with learners. Teacher B also did not veer very far from the lesson plan that was given to the teacher in the training session. Teacher B's lesson was focused on practicing mapwork calculations rather than the introduction to content knowledge.

Open Sankoré as a narrative media form

Teacher B also uses Narrative media forms to introduce content knowledge. As the teacher introduced co-ordinates the teacher showed learners the main cardinal points on the software. Therefore, the presentation of the main cardinal points on the map was improved. It is important that learners have a solid understanding of direction before teachers move on to direction. This is evident in Figure 5.1.1 where co-ordinates form one of the knowledge bases that should be included in the learner's cognitive map.

As the teacher introduces lines of latitude and longitude, it is evident that the teacher used a narrative media form. The teacher used the pen function on the software to draw and point to lines of latitude and longitude.

Teacher A: *So, lines of latitude always remember the line of latitude runs (04:07 showing the learners an example of lines of latitude on the software) Sorry ... I am just trying to find my pen. Horizontally. Do we see that? That this is a line of latitude and a line of longitude runs vertically. So, looking for a line of latitude remember that it is a line that runs horizontally and looking for a line of longitude it is the line that runs ...*

Learners: Vertically.

Here, the learners could clearly see on the software what a horizontal line and a vertical line look like. Learners are also able to see the differences between the two lines. Unlike Teacher A who used the highlighter to show learners the concept, Teacher B used the pen and the pointer to show learners the differences. The pen and the highlighter provided the same learning benefits as the highlighter. Teacher B also used the zoom in and out function to improve visibility for the learners. However, the teacher did not use the line function to draw a grid over the topographical map. Figure 4.5.7 shows how the teacher presented content knowledge on Open Sankoré.

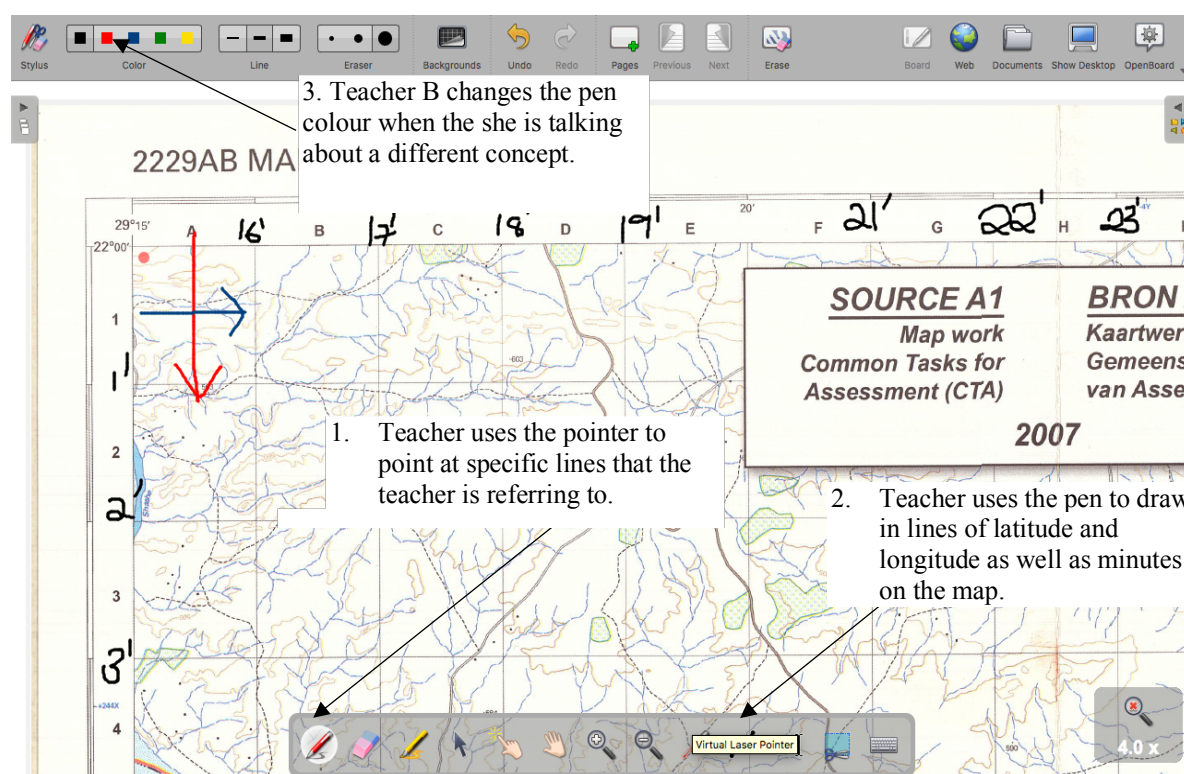


Figure 5.4.5: Using the pen and pointer to present Co-ordinates on Open Sankoré

The teacher also uses narrative forms of media to teach scale and distance on the same map. Teacher B used the same functions on the software as Teacher A. Both teachers used the straight line and ruler, as well as the text box to teach distance. The teacher showed learners with the software, as she introduced scale and showed what a line scale and a ratio scale looks like, and where exactly to find it on the map. It is evident that within this example, the use of narrative media forms was used. The teacher simply showed learners on the map, where the two scales were on the map. There is no further engagement from learners.

Teacher B like Teacher A, also used the narrative media forms to orientate learners around the map. The teacher showed learners where they should be measuring from, when there is a specific calculation.

***Teacher B:** lets quickly do an example. Using the line scale so the scale at the bottom of the map. Measure from spot height 625 that's in block G15 to spot height 582 in H14.*

Here, in this example the teacher showed learners where to measure on the map. A narrative media form was used because the teacher was just showing what conventional signs the learners should be measuring from. Teacher B also used this method in the co-ordinates lesson where the teacher showed learners what conventional sign on the topographical map the learners should be measuring from.

***Teacher B:** Can you do this. Let's find the school in F8 I'm going to move it up now for you. okay so follow the same steps we did with the spot height. Try it on your own. F8 the school. Guys first of all you need to know your keys to know what the symbol is. What the key for school is. (26:06 Learners did not know the conventional sign for school). Remember you have the map in front of you.*

Open Sankoré as an interactive media form

Teacher B predominately used the interactive media form within their mapwork lessons while using Open Sankoré, when they taught with Open Sankoré. It was evident throughout the lesson that the teacher was constantly asking for learner's feedback. This ensured that learners are understanding content knowledge. In these two observations learners battled to understand content knowledge, based on learners' feedback to the teacher. While the teacher was using Open Sankoré, the teacher was able to pick up on learner's misconceptions within both lessons.

Teacher B did not use any other teaching tools to amend misconceptions. The teacher only referred to Open Sankoré. The teacher used Open Sankoré to show learners where they went wrong in their calculations. In this example the teacher asked for feedback from learners and assisted them in getting the correct answer, by showing them how to work out the co-ordinate on Open Sankoré. The teacher utilised the pointer to show learners how.

Grade 8 Co-ordinate lesson

Learner: Its 22 degrees and 6 arch minutes south and then for longitude it is 29 degrees and 18 arch minutes east.

Teacher B: Okay ... You have missed your ... do your ... try doing your arch minutes again and then someone else has a different answer ... Loud hey?

Learner: Yes mam ... it's 22 degrees 7 arch minutes south and 29 minutes and 20 arch minutes east.

Teacher B: Okay so let me give you my answer and then you look where you went wrong. it is 22 degrees 7 arch minutes south 29 degrees and 19 arch minutes East. Let's look together. Let's do it together. You look where the centre of the landing strip ... remember, let me show you ...

Here, learners were interacting more with the map that is on Open Sankoré than on their own physical map. The teacher used Open Sankoré to assist learners in filling in the missing minutes on the map. The teacher asked learners to tell the teacher what minute line the teacher was pointing at (see Figure 5.4.8). Teacher A also used Open Sankoré in this manner. The difference was that Teacher A filled in minutes with a textbox and Teacher B did it with the pen.

Grade 8 co-ordinate lesson

Teacher B: Remember we are looking at arc minutes to move from 15 minutes and gradually move to ...

Learners: 16 minutes.

Teacher B: 16 minutes ... so 16 minutes...

Learners: 17 minutes, 18 minutes. 19 minutes... *(continues as the teacher points to the line and writes it in)*

Teacher B: Thank you. Yes, you must speak loud ...

Open Sankoré as a collaborative media form

There were not many examples of the teacher's lessons being collaborative. Only towards the end of the lessons when the teacher felt that the learners had a good sense of understanding of content knowledge. Towards the end of the distance lesson Teacher B allowed learners to tell her what to do on the software. Open Sankoré was used as a collaborative media form because the learners were working together with the teacher to come up with a certain conclusion.

Grade 8 distance lesson

Teacher B: *Okay, its N13 so you took your ruler and your measured between the two places. What was your ...*

Learner: *5,4.*

Teacher B: *Okay 5,4 and then what did you do after that?*

Learner: *5,4 times by 0,5.*

Teacher B: *Yes.*

Learner: *Times by 0,5 and then we get to the answer we times it by 1000.*

Teacher B: *No! we're not doing it in metres we're doing it in kilometres. Okay, thank you between Mapesu and the nearest diamond mine we got 5,5 centimetres and you needed to give it to me in kilometres so you times by 0,5 and you get 2,75 kilometres.*

This was also an example of collaboration within the co-ordinates lesson. Unlike with Teacher A, learners were not working in groups and were working individually. It must be highlighted that for a digital tool to be considered collaborative, learner agency must be expressed. Open Sankoré contributed as collaborative because even though learners were instructed to work individually, learners discussed content knowledge with one another.

It was interesting to see that by using Open Sankoré in the teaching of co-ordinates, it sparked conversation between learners. Even if learners had worked quietly on their own it is considered as collaborative, because learners engaged with the map on Open Sankoré and applied it to their own physical map, and then expressed that knowledge to the teacher. Learner agency was expressed in both scenarios, and therefore would be considered as a collaborative media form.

Grade 8 co-ordinates lesson

Teacher B: *Okay let's do one more case study. Uhm okay you're planning an end of year party at Schroda dam. What co-ordinates would you put on the invitation for your guest to arrive at the right place. You are throwing a party ... Do you want me to come? I don't know where it is. Find Schroda dam. What co-ordinates would you put? Quietly, on your own focus and I'm sure you will get it right. Block out the distractions.*

Learner: *Mam is this Schroda Dam?*

Teacher B: You have to tell me Okay thank you have you found it.

Learners: Yes Mam.

Teacher B: Which block is it?

Learner: Mam it is between K and L

Teacher B: K and L ... Between K and L quietly now everyone has found it?

Open Sankoré as an adaptive media form

There is no evidence within Teachers B lessons that the Open Sankoré was used as an adaptive media form. Although the software itself does not transform according to learner's feedback it does however adapt to teacher's methodology. It must be highlighted that the teacher was still in full control of the software and it did accommodate for teacher's pedagogy on its own. The software allowed the teacher to use other programmes while the software was still running. For instance, the teacher accessed a google doc and switched interchangeably between the two interfaces. Teacher A also used this functionality within the software.

Open Sankoré as a productive media form

As mentioned in Teacher A's analysis, Open Sankoré cannot be used as a productive media form because learner's do not have accessibility to the software. Learners cannot produce anything based on content knowledge with the digital tool.

Table 5.3.2: Teacher B's use of Open Sankoré expressed as Laurillard (2002) Media Forms

<i>Media forms</i>	<i>Affordance</i> →	<i>Evidence</i> →	<i>What pedagogical value does Open Sankoré add to mapwork skills? (the map, the mind, the world)</i>
Narrative	Non-linear: Display of map on Open Sankoré	Multimodality: Map and written text were used in the lessons.	<i>The map:</i> Presentation of a Topographical/Orthophoto is clearer on Open Sankoré. <i>The mind:</i> Teacher was able to show what is scale and what are lines of Latitude and Longitude by showing learners where this is on the topographical map as well as different types of scale that was on the map. <i>The World:</i> Learners are exposed to the digital tool which is in the external environment.
Interactive	Immediacy: There is immediate feedback from learners because the teacher is constantly asking questions.	Immediate Feedback: There is verbal feedback of content knowledge from learners to teacher based on the topographical map which is displayed on Open Sankoré during the lesson.	Re-description of concepts: <i>The Map:</i> Learners are shown correct mapwork calculations on the software. <i>The mind:</i> Misconceptions of mapwork are amended by the software. Teachers show learners where they went wrong on Open Sankoré. Guide learners verbally. <i>The world:</i> Communication between the teacher and learner in the external environment.

Communicative	Collaboration: Learner provides feedback to the teacher. This sparks a discussion amongst the class.	Discussion: Class/ Group: • Open Sankoré sparked conversation amongst learners. Learners were able to express ideas of content knowledge. • Discussion formed between the teacher and the learner after feedback.	Re-description of concepts: <i>The map:</i> Learners engage with the Map on Open Sankoré, as well as their physical map. <i>The mind:</i> Learners internalised mapwork concepts such as scale and co-ordinates, discussing these concepts with teachers and learners. <i>The world:</i> Most communication is with the teacher.
Adaptive	Diversity ▪ Able to different documents in the software access	Reproduction: Experiment/ Role play: None	Concretising Theory: Practice None

Links between map, the mind and the world in Teacher's B lessons

Innes (2009) states that to encourage *spatial competence*, the teacher makes sure that in every lesson that was taught, that the map was explained in relation to the world, to give learners a better understanding of the map.

There were a variety of examples of where the teacher related content knowledge to the real world. The first was in the co-ordinate lesson where the teacher related lines of latitude and longitude to the Equator and the Greenwich Meridian. Teacher A also did this in their lesson. The teacher also related degree, minutes and seconds to cutting pizza. Even though this is not geographically linked to the real world, the teacher assisted learners in making a link between content knowledge and something that the learners were familiar with in the real world. Teacher A made considerably more links to the real world than Teacher B.

Grade 8 co-ordinate lesson

Teacher B: *So let's think of 1 degree as one whole pizza right and one whole pizza is one degree and we now want to look at arch minutes. So, what did we do so we cut that pizza into 60 slices. Now every slice is an arch minute. Do we understand that?*

Learners: *Yes Mam, so 1 whole pizza 1 whole degree, 1 whole arch minute ... 1 arch minute is 1 slice of that pizza.*

Teacher C: Lesson Analysis

Lessons observed: One

Topics: Grade 9 Direction, Bearing, Distance (On an Orthophoto)

Time: Twenty-five minutes

Teacher C is an experienced teacher and the teacher had a positive attitude towards teaching with the software. One Grade 9 lesson was observed, and content knowledge was taught eight weeks prior to these lessons. Teacher C had a very brief introduction to the lesson and focused on doing mapwork calculations such as distance, direction and bearing. Teacher C did not really follow the suggested lesson plan and taught through her own experience.

Unfortunately, due to time constraints, Teacher C did not have enough exposure with the software. Teachers A and B had had exposure to the software a month before teaching with it, whereas Teacher C could only attend the training session a week before the lesson was scheduled to be observed.

Teacher C: (02:28) *Teacher C only learnt how to do it today). So, we just had to wing it and we are going to see if this helps and you need to tell me guys, does it help can you see all of that ... okay?*

Open Sankoré as a Narrative media form

The teacher used Open Sankoré as a narrative media form when the teacher showed learners when she orientated the learners around the orthophoto map. The teacher explained to the learners where the map code was, along with the ration scale. The teacher used the magnifying glass rather than the zoom in and out function. The teacher also used a narrative media form to show learners how to do a certain calculation such as distance or bearing calculation on the

Orthophoto. The teacher also used the calculator to show learners how to calculate a distance on a map. Teacher C was the only one who used the electronic calculator during the lesson.

Only after the teacher was finished with what she was doing on the software were the learners able to do it on their physical maps.

Teacher C did not ask for any feedback and learners were not engaging with the Orthophoto. The learners were only listening and watching what the teacher was saying and doing on the software.

***Teacher C:** I am going to do is we are going to put the cross over there and then I am going to stretch it. I am going to zoom in for you now okay ... alright and I joined my two places okay. Now what I want you to do please where is my apps (07:42 **The teacher needed assistance during the lesson in finding the app that contained the ruler, this was included in the training before hand**). Alright what I want you to do is put your dot on the opening remember we are doing it in pencil.*

The teacher also used the magnifying glass function to show learners the features on the map such as aeroplanes. The teacher also used the magnifying glass function to show learners where to measure from on the specific place on the map. In this way Open Sankoré was used as a narrative media form to present content knowledge to the learners.

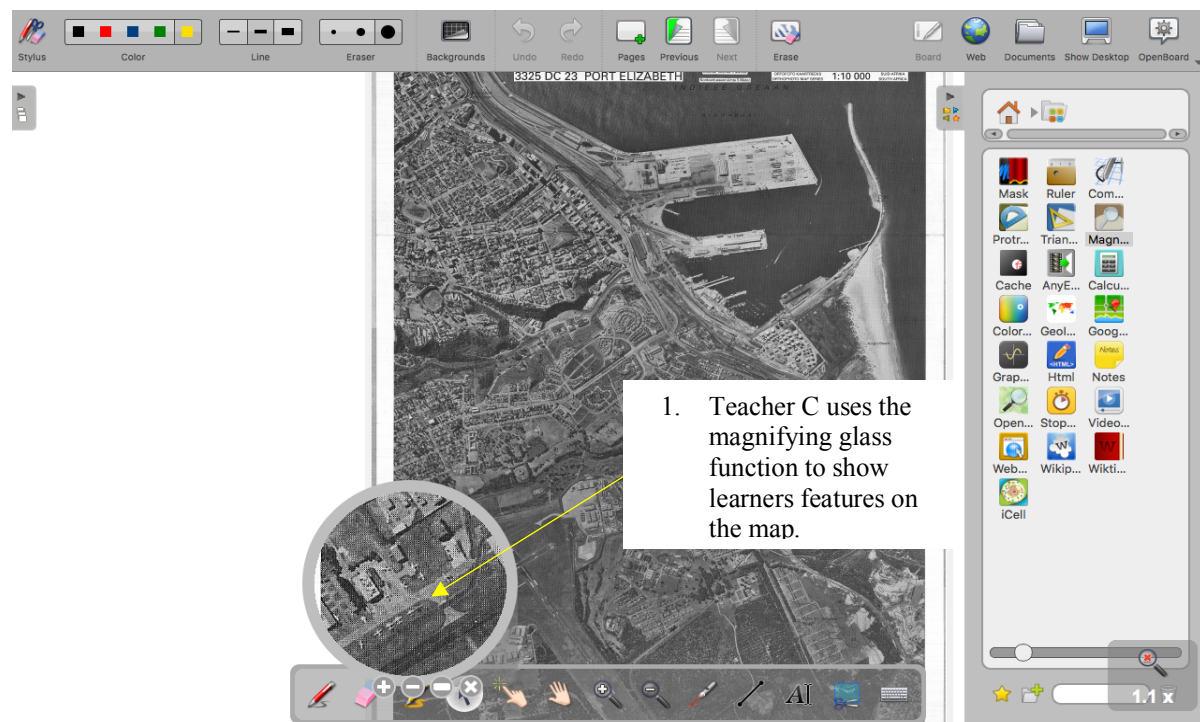


Figure 5.4.6: Using the magnifying glass to show learners features on the map

Teacher C: *Okay ... there it is there can you see that there are airplanes there? (11:56 The teacher used the magnifying glass to show learners features on the photo, something learners would not have noticed if they were just looking at the physical orthophoto).*

Learners: *No.*

Teacher C: *No, Are you blind? Okay look here I want you to calculate the length of your runway. The one that travels North West can you see this one.*

The teacher also uses the narrative media form to familiarize learners with conventional signs such as contour lines. The teachers used this media form to orientate learners on the map. This was also used by Teacher A and B.

Teacher C: *So, remember these dark lines that we have on here what do they represent?*

Learners: *Contours.*

Teacher C: *Contours remember sometimes you also going to have other symbols (pause) there was one here somewhere. There is another over there it is a dot with a number next to it. What is that?*

Learners: *A spot height.*

Open Sankoré as an interactive media form

There was also evidence of Teacher C using Open Sankoré as an interactive media form. This was when Teacher C asks for feedback from learners, as well as when learners engaged with the map that was on Open Sankoré. Teacher C used the interactive media form to teach direction on the map. The teacher drew a compass by using the straight-line function and asked learners for specific directions when she pointed to the cross that was made. The teacher was relying on learners' feedback to indicate whether the learners were familiar with content knowledge. When the learner's feedback was incorrect the teacher rectified it by re-doing the calculation on the software.

Teacher C: *The East -West line is nice when you start having the other eight cardinal points of West South West etc. So, what is the direction that you got? Hands up. Let's ask somebody else. Okay what did you get?*

Learner: *I said East South East.*

Teacher C: *You are going from the Spot height to the harbour. So how can you be going South? Okay, who has got another answer for me? What do you have?*

Learner: *I have North East.*

Teacher C: *North East. Do you all get that?*

Learners: *Yes, mam.*

Teacher C: *You went in the opposite direction alright are we happy with the direction? Can we do it on our own. (Showing the learners on the software).*

In this example Teacher C used blended learning. This is where the teacher used technology as well as traditional teaching methods, such as the whiteboard to explain a concept. The teacher referred to the software as well as the whiteboard. While the teacher was explaining bearing, she referred to the line on the software that she used to do a direction question. Teacher A explained from the cross that Teacher C drew on the Orthophoto map that every direction has an angle. The teacher used the pointer to show learners the angle on the cross. The teacher then switched methodologies and drew a cross on the whiteboard with the particular angles that North, East, South and West would have. The teacher relied on learner's feedback to identify any misconceptions.

Teacher C: *So, we have these four main cardinal points, we all agree with that? Okay and I just said to you that North is taken as nought ... okay. You guys are mathematical geniuses what angle is that?*

Learners: *90 degrees.*

Teacher C: *Therefore, East is 90. What is South going to be then?*

Learners: *180.*

Teacher C: *And then what is West going to be?*

Learners: *270.*

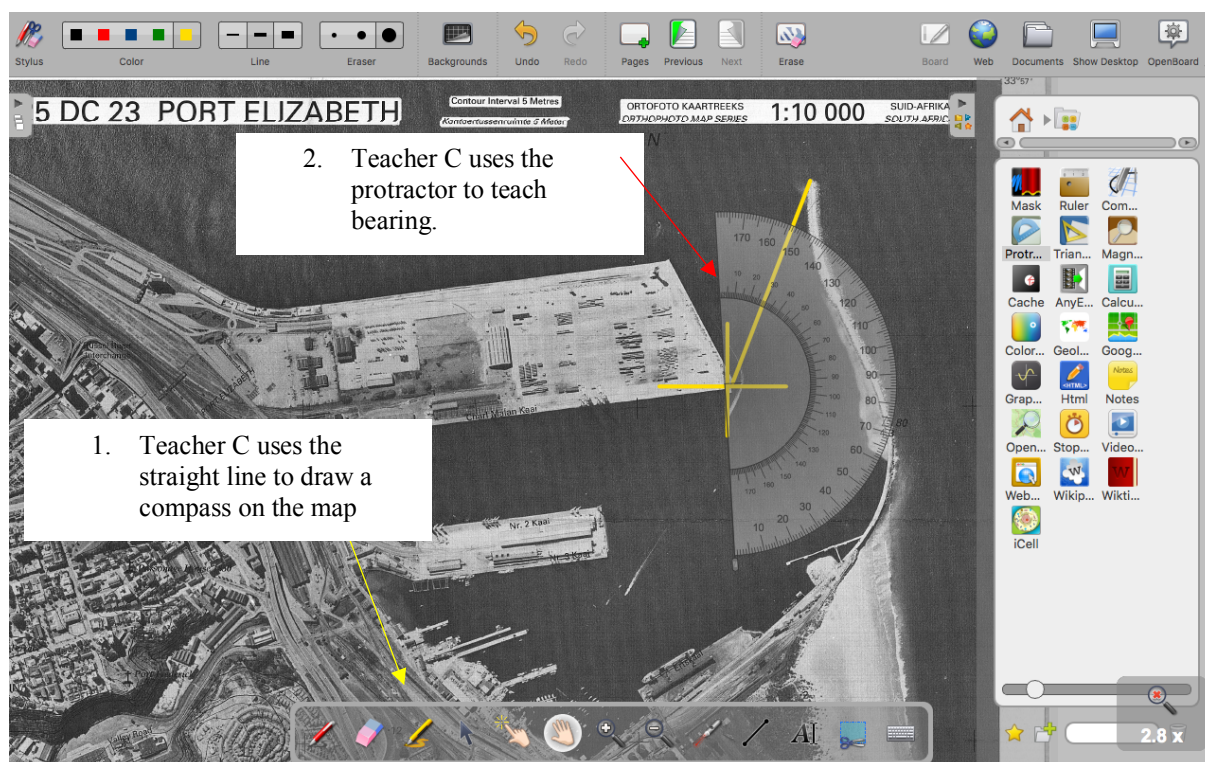


Figure 5.4.7: Using the straight line and electronic stationary to teach bearing

Open Sankoré as a communicative media form

The teacher does not utilize this media form as well. Because of time constraints, the lesson ended before the teacher could finish. This was due to the time that was spent on finding certain tools and applications on the software, while teaching. Teacher C allows learners to work in groups just as Teacher A did. The difference is that Teacher C gave learners all the questions and then let them do it in groups, whereas Teacher A asked learners to do one question and the teacher then went through it with them after they had finished.

Learners were still able to discuss content knowledge with peers as well as the teacher. As learners were doing the activities the teacher walked around the class to assist learners who were struggling. Teacher C also placed the map on Open Sankoré to show where learners should be measuring from. Teachers A, B and C all used method in their lessons.

***Teacher C: (Walks to the next group).** What have you done for your first one? How did you get to beach? because that is the name, so you should be there. Okay. So, which one are you on now?*

***Learner:** Number 2.*

Teacher C: Okay have you found it?

Learner: Yes mam.

Learner: Mam, can I ask do we measure from here?

Teacher C: Measure from there.

Learner: Thank you mam.

It is evident here that a conversation had started between the teacher and learner. The learner expressed learners' agency by asking the teacher a question on what the learner was not sure of. Teacher C utilized the collaborative media form because learners had interacted with the Orthophoto on Open Sankoré and needed to apply that knowledge onto the physical Orthophoto.

Open Sankoré as an adaptive media form

Although Open Sankoré is not adaptable to learner's feedback, this is the same as Teacher A and Teacher Cs lessons where the software did not offer this type of functionality. What the software did offer however was showing that teachers are able to switch between maps. In Teacher A and Teacher Cs lessons the teachers switched from the topographical map to the orthophoto and vice versa.

Learners: Yes mam.

Teachers C: What were you going to ask?

Learner: I was going to ask, what if you don't know the symbols?

Teacher C: Now remember if you don't know what one of the symbols are on the orthophoto. Where can we look to find out what that symbol is? Where is my key because I don't have a key on my orthophoto?

Learner: The topographical map (Here the teacher switches to the topographical map on Open Sankoré).

It is evident within this example that the software is diverse and can access different types of maps. There is no evidence within this teacher's lesson that the teacher used other programs such as google docs, while teaching with Open Sankoré, unlike Teacher A and Teacher C.

Open Sankoré as a productive media form

As mentioned in Teachers A and B's analyses Open Sankoré cannot be used as a productive media form because learners do not have accessibility to the software. Learners cannot produce anything based on content knowledge with the digital tool.

Table 5.3.3: Teacher C's use of Open Sankoré expressed as Laurillard (2002) Media Form

<i>Media forms</i>	<i>Affordance</i> →	<i>Evidence</i> →	<i>What value does Open Sankoré add to mapwork skills? (the map, the mind, the world)</i>
Narrative	Non-linear: Display of map on Open Sankoré	Multimodality: Map and written text were used in the lessons. Straight line Magnifying Glass Electronic stationary	<i>The map:</i> Presentation of a Orthophoto is clearer on Open Sankoré. <i>The mind:</i> Teacher was able to show how to handle distance, direction and bearing by showing learners where this is on the orthophoto map. <i>The world:</i> Learners are exposed to the digital tool, which is in the external environment.
Interactive	Immediacy: There is immediate feedback from learners because the teacher is constantly asking questions.	Immediate Feedback: There is verbal feedback of content knowledge from learners to the teacher based on the orthophoto map which is displayed on Open Sankoré during the lesson.	Re-description of concepts: <i>The map:</i> Learners are shown correct mapwork calculations on the software. <i>The mind:</i> Misconceptions of mapwork are amended verbally and shown on the software. <i>The world:</i> Communication between the teacher and learner in the external environment.

Communicative	Collaboration: Learner provides feedback to the teacher. This sparks a discussion amongst the class. Learner asks teacher questions	Discussion: Class/ Group: ▪ Learner agency is expressed by asking teacher questions ▪ Discussion forms between the teacher and the learner.	Re-description of concepts: <i>The map:</i> Learners engage with the Map on Open Sankoré as well as their physical map. <i>The mind:</i> Learners internalised mapwork concepts such as distance, direction, bearing. Discussion of these concepts occurred between teachers and learners. <i>The world:</i> Most communication is with the teacher.
Adaptive	Diversity ▪ Able to switch between maps on the software	Reproduction: Experiment/ Role play: None	Concretising Theory: Practice None

Links between map, the mind and the world in Teacher C's lessons

There were very few examples within Teacher C's lesson, where content knowledge was related to the real world. The only example the teacher used in the lesson was when the teacher introduced direction and bearing to learners. The example the teacher used is if the learners had to travel to C - is linking content knowledge to a suburb that most learners were familiar with. Learners had to apply the knowledge of bearing to the external environment.

***Teacher C:** So, I want to go to Sandton as an example okay we all know Sandton is North okay so that is North remember. (Teacher is pointing in a northerly direction). Do you remember that? So that is North but now I am going in an angle of 6 degrees north so then I am going to get to Sandton.*

In this example the teacher explained bearing by explaining that it was based on the direction North and is at six degrees. This may confuse learners with the degrees on co-ordinates. Teachers must be aware of what geographical terms they use to mediate knowledge to learners. The teacher should have emphasised that is six degrees North of the compass or protractor.

Teacher's A, B and C use of Media forms when teaching with Open Sankoré

Table 5.3.4: The Teacher's use of Open Sankoré in each Media form

The use of Open Sankoré within a Media form during mapwork lessons					
Teacher:	Narrative	Interactive	Collaborative	Adaptive	Productive
A	✓	✓	✓	X	X
B	✓	✓	✓	X	X
C	✓	✓	✓	X	X

Teachers perceptions of how the software was useful to teach mapwork skills before they were taught with Open Sankoré, is very similar to how the software was used in the teacher's lesson (see Tables 5.3.1 and 5.3.5). The teachers were aware of the pedagogical value of Open Sankoré even before they taught with it. It is evident here that there was an unintentional benefit that the training session offered to teachers participating in the study. The main goal of the training session was to show teachers how to use the software and how to incorporate it into mapwork lessons. Lesson guidelines were given to teacher's which had suggestions on how to structure lessons (see Appendix C). An added benefit of the training session was that it assisted teacher's in critically engaging with the software. The training session provided teachers with a platform to consider how Open Sankoré could enhance their mapwork lessons. As a result, teachers foresaw the benefits of the software before they started teaching. This is an important factor because it contributed to teacher's positive attitudes towards implementing the software within teacher pedagogy.

5.6 Conclusion

The most commonly used media form that teachers used in this particular study fell between the interactive media form and the communicative media form. It was evident within all seven lessons that teachers encouraged learners to interact with the software, by questioning learners on certain calculations, as well as areas on the map. Later in lessons, learners started asking their own questions about content knowledge addressed either to peers or the teacher. In most lessons there was constant communication between teachers and learners. "Conversation can play a big role in the construction of knowledge as the teacher guides learners in this process" (Ndlovu, 2015, p51). Although the act of conversation plays a role in learning, the teacher also plays an important part within facilitating the process.

For effective learning to take place, the teacher must monitor and influence the conversation into appropriate learning paths. Powell and Kalina in Ndlovu (2015), states that teachers should promote learners to communicate for them to critically engage with knowledge. It is evident here that it is the teacher's responsibility to produce critically engaging conversations within the learning environment. In this case Open Sankoré assisted teachers in producing these discussions, either between the teacher and learner or between learners themselves but, it is the teacher that drives the processes and not the ICT itself.

Chapter 6: Findings

6.1 Introduction

In this chapter, findings of the study will be discussed to conclude whether Open Sankoré is a useful tool to improve the teaching of mapwork skills. It has come to the realization of the researcher, during the process of this project, that to improve the teaching of mapwork skills there must be an in-depth analysis of the learning process and how Open Sankoré can assist with the learning process; for learners to have a better understanding of mapwork skills. Innes (2009) also considers the learning process, when there is the transferral of knowledge from the map to the mind and from the mind to the real world. The transferral of knowledge from the teacher to the learner considers the modification of the cognitive map. The use of media forms along with teaching practices, assists the learning process by guiding the modification of the learner's behaviour through the mediation process.

In this research, the effectiveness of how teachers taught with Open Sankoré within the media forms, to mediate knowledge does vary; but all three teachers contributed to the learning processes within the CF in some way. The study of the media forms in the context of Open Sankoré is important within the study because it provides a better understanding of the true pedagogical value of Open Sankoré. The media forms were considered as part of the main themes within the study. Along with the media forms, other themes were developed through the data analyses which comprised *teacher attitudes, lesson pace, training, usability and adaptability of Open Sankoré within pedagogy*; as well as *differences within the learning environment*.

6.2 Pedagogical Value of Open Sankoré within Laurillard (2002) Media Forms

In this section the pedagogical value of Open Sankoré will be identified within the media forms, based on the seven lessons that were observed, as well as the reflective interview. The discussion will also identify what pivotal geographic classroom practices from the 21st Century road map Open Sankoré supported to teach mapwork skills. This is an important attribute to the research because it focuses not only on the learning process, but also on the learning process within the geographic context. Open Sankoré may support learning processes within the CF but for Open Sankoré to have pedagogical value within the realms of mapwork, it must encourage geographic teaching practices (see Table 2.1.). The main goal of these practices is to strengthen teacher's geographic instruction (Chandler & Munch, 2016).

Authentic Intellectual Work	<i>Road Map for 21st Century Geographic Education: Six Geographic classroom practices</i>
Construction of Knowledge	1. Posing Geographic Questions 2. Acquiring Geographic Information
Disciplined Inquiry	3. Organizing geographic information 4. Analysing geographic information 5. Answering questions/designing solutions 6. Communicating geographic information
Elaborated Communication	
Value Beyond School	

Open Sankoré as a narrative media form to teach mapwork skills

It is evident in teacher's lessons that *spatial competence* is developed due to the visibility of the cartographic map being enhanced on Open Sankoré. Learners also have access to the physical map which is in front of them. Maps are an essential part of developing *spatial competence*, because "Maps animate the cognitive process that allows for geographic reasoning to occur" (Innes, 2009, p45). It is evident, looking at Teachers A, B and C that the accessibility and the visibility of the map is improved and therefore it is easier for teachers to mediate knowledge from the physical map to the mind (see Figure 5.4.1- 5.4.3).

As a result, the mediation process is enhanced, and it leads to an incorporation of new knowledge within the learner's cognitive map. Teacher A also highlighted that they preferred having the software on the board, while the learners walked into class because it encouraged learners to start making links from the map that was on the software with their existing cognitive maps, even before the teacher started teaching.

Teacher A also emphasised by using the programme, that their perspective of the map was clearer. As result, teacher's *spatial competence* had improved. This is important because for teachers to encourage geographic enquiry "they need to be aware of a wider range of spatial information products and how to use them effectively" (Innes, 2009, p130). Teachers' enhanced *spatial competence* will enable teachers to use appropriate teaching tools that will encourage the six geographic classroom practices.

Teacher A: *I think with the co-ordinates as well it helps me seeing it as well being able to split that for them on the board. It just I think it takes less time if you think about it.*

To enhance the visibility of the physical map Teacher's A and B used the zooming in and out function for learners to see what part of the map they are referring to. Teacher C opted for the magnifying glass instead of the zoom in and out function. Teachers A, B and C used the straight line, highlighter and pointer to show learners what areas the teachers were referring to on the map, which is on Open Sankoré. Through this pedagogy learners were able to *acquire geographic knowledge* by watching what the teacher was doing on Open Sankoré, as well as *organizing geographic knowledge* in their cognitive maps

Pedagogical value of Open Sankoré as an interactive media form to teach mapwork skills

All three teachers used Open Sankoré as an interactive media form within the study. Although the actual software cannot provide feedback for learners on its own, the software relies on the teacher, to guide learners as to where they went wrong. Ndlovu (2015) has stated that feedback can be expressed through an ICT or through written tests or discussions. Open Sankoré provided pedagogical value because it enabled teachers to show learners step by step where they had gone wrong in a certain calculation. Innes (2009) emphasised that to develop spatial skills amongst learners, teachers should teach with geographic material that provides immediate feedback. Immediate feedback from the teacher or a digital tool “gives learners information about how to adjust their performance” (Ndlovu, 2015, p60).

Immediate feedback is important to develop *spatial competence* because learners can adjust their cognitive map based on how the teacher has mediated knowledge with the assistance of Open Sankoré. In this study learners are providing feedback to teachers by a question and answer process. According to Ndlovu (2015) questions are helpful in assisting teachers to mediate new knowledge. As a result, learners who are engaging with the map on Open Sankoré are participating in *answering geographic questions, acquiring geographic knowledge and organizing geographic information*, which are all knowledge processes from the 21st century road map (see Table 2.1.1).

Innes (2009) has identified within her research of *Maptrix Geomatica* (which is a mapwork digital game), that learners struggled with being accurate within their mapwork calculations, even though the game provided a step-by-step process of distance, bearing, direction, height and gradient. Open Sankoré can assist aided learners to do calculations correctly, because instead of learners reading set processes, teachers are showing learners these processes. This is evident within Teacher B's responses because the teacher highlighted that it was easier to show learners something, rather than telling learners what to do.

Pedagogical value of Open Sankoré as a collaborative media form to teach mapwork skills

It is evident within the teacher's observation that it is not ICT itself that encourages collaborative learning but how the ICT is used that is important. Therefore, the quality of learning with the ICT is "constructed and guided by the teacher" (Ndlovu, 2015, p31). Ndlovu (2015), has categorized a collaborative media form, where learners must be in control of the ICT. However, the researcher has interpreted a collaborative media form as an ICT that encourages communication between teachers and learners, to reach a particular learning goal. Teachers or learners can be in control of the media, as long as teachers and learners are working together, to unpack content knowledge. To ensure this, teachers must be constantly motivated to teach Social Science. This can be done by having regular teaching programs.

In this study the learner is not in control of Open Sankoré, but discursive learning processes are evident within all seven lessons. This is because there is constant communication between teachers and learners. In the interactive media form, there was more focus on teachers asking questions to scaffold and mediate knowledge to learners. In the collaborative media form, how the learners express agency towards mapwork skills is of interest. Innes (2009) stated that to acquire spatial skills learners must be able to work at their own pace as individuals. There is some truth to this statement because for the learners to work together with the teacher or other learners, agency must be expressed from the learner, for the interaction to occur. Even though Innes (2009) promoted individual work, her research found that a large percentage of learners preferred to work with someone during mapwork lessons.

Open Sankoré provided a platform where learners could express their content knowledge. Teachers A and B, during their mapwork lessons asked: "*What do I do next?*" when they were doing a specific calculation on the board. This enables learners to engage with the software and guided the teacher on how to do the calculation. Teachers A and C used activities that were given to them during the training session as group work. Teachers A and C showed learners the area on the software. While learners were discussing content knowledge with each other, they were also engaging with the software. In Teachers A, B and C's lessons, learners also asked teachers questions about content knowledge on what was on the map, thereby learner agency was expressed. This is another example of how teachers and learners worked together within mapwork lessons.

Communication within the learning environment is very important for the learning process.

Learners can apply newly learnt concepts into the external environment. While teachers and learners are communicating with each other during the lesson, learners can acquire *geographic knowledge, pose geographic questions, answer questions or design solutions and communicate geographic information*. These are all practices that are part of the 21st century road map.

Pedagogical value of Open Sankoré as an adaptive media form to teach mapwork

Open Sankoré is not the type of digital tool that can adapt to learner's responses. However, teachers did express that if learners had access to the software, lessons could be more interactive and learners would have even more accessibility to the map than they had had before. At the schools examined, learners were not allowed to take maps home except by special request. If learners had accessibility to the software they would be able to access different types of spatial information such as different topographical maps, satellite images and street views of areas. Open Sankoré could be adaptable in the way whereby learners were able to access different types of spatial information. However, this requires further research on how the software can adapt to learners' needs.

Based on the hypothetical fact that learners have access to Open Sankoré, learners can apply new knowledge that has been mediated by teachers through Open Sankoré. The adaptive media form encourages learners to critically solve problems on Open Sankoré. As a result, learners can assist in solving geographic problems within the community by interpreting and synthesizing maps on Open Sankoré. By learners critically engaging in these activities on the map they can *acquire geographic knowledge, pose geographic questions, answer questions or design solutions and communicate geographic information*.

Pedagogical value of Open Sankoré as a productive media form to teach mapwork

Open Sankoré does not have a productive element yet because the software is not accessible to the learners. The accessibility to the software would enable learners to create their own spatial information on the software, which could develop *spatial competence*. However, this is a realm that could be studied in future research. If learners can produce their own spatial data on Open Sankoré, they would be able to *acquire geographic knowledge, pose geographic questions, answer questions or design solutions and communicate geographic information*.

The table below represents six main practices of the 21st Century road map that geography teachers should encourage Open Sankoré to support within the Narrative. These are Interactive, Collaborative media forms. In the table the adaptive and productive media forms are marked

with a black square because these are assumptions made by the researcher, supporting the fact that if Open Sankoré was working within such forms, it would be able to support such beneficial geographic practices.

Table 6.2.1: The six geographic practices that Open Sankoré can offer

21 st Century Road Map: Six Geographic practices supported by Open Sankoré:						
Media Forms:	Posing geographic questions	Acquiring geographic information	Organizing geographic information	Analysing geographic information	Answering questions/ designing solutions	Communicating geographic information
Narrative		✓	•			
Interactive		•	•		•	
Collaborative	•	•	•	•	•	•
Adaptive	▪	▪	▪	▪	▪	▪
Productive	▪	▪	▪	▪	▪	▪

In this study it is evident within the seven lessons that in every lesson that Open Sankoré was expressed as a media form it added pedagogical value in the teaching of mapwork skills. This is because Open Sankoré mainly supported the discursive phase within the CF. Open Sankoré was also able to support the 21st Century road map. According to Table 5.3.6 the more integrated use of Open Sankoré is, the more geographic practices it will support.

In the instance where Open Sankoré was not expressed as a media form within the lesson, the tool still shows potential within those media forms, if learners could have access to the software. Open Sankoré mostly supported discursive and communicative phases within the CF.

6.3 Teacher Attitudes Towards ICT and Mapwork VS Effectiveness of teaching

It has been highlighted within Chapter 4 that for the successful implementation of ICTs, teacher's attitudes and perceptions about ICT must be considered. Ndlovu (2015) stated that teachers' perceptions and attitudes towards ICT affect how it is integrated within the learning process. This is also emphasised by Mbene (2009). Teachers that tend to have negative attitudes towards ICT tend to be unwilling to use them effectively in their pedagogy. Innes (2009) states that teacher's and learner's positive attitudes towards mapwork impacted the enrolment of Maptrix Geomatica positively.

All three teachers have expressed that they had a positive attitude towards teaching with Open Sankoré before teaching with it. These positive attitudes were reflected in Teacher A and B because they showed a sense of willingness to incorporate Open Sankoré into their pedagogy,

because in lesson observations they were not struggling to access tools and applications that had been dealt with in the training sessions. Teachers A and B attended the training session a month before and had a lot of time to practice with the software. The teachers also applied the lesson's guidelines in their pedagogy which made them feel more comfortable to teach with the software.

Even though Teacher C expressed a positive attitude towards incorporating Open Sankoré within their pedagogy, this was not reflected in her lesson. She needed assistance in accessing applications and tools that had been dealt with in the training session, while the teacher was teaching. This is a disappointing result as the teacher is part of the ICT training committee in the school. There could be many factors that contributed to the teacher's unpreparedness of the lesson. The first contribution could have been the lack of time that the teacher had spent with the software. She could only attend the training session a week before she had to be observed. The teacher is one of the senior geography teachers at the school and did not have time to attend the training session at the beginning of the month. The second is that the teacher did not follow the suggested guidelines. Since the teacher is used to incorporating ICT within the classroom she may have overlooked how important the training session and the lesson guidelines were (see Appendix C) in order to incorporate Open Sankoré effectively. Thirdly, the teacher only downloaded the software on the day of the observation; therefore, the teacher had very little exposure to the software.

It is evident here that even though the teacher had a positive attitude towards ICT and had a good understanding of mapwork concepts, there were other factors that contributed to implementation of the ICT with the teacher's pedagogy. She did not necessarily have a good experience with Open Sankoré, but she still found that they would use it in future instances. Although her attitude is important within the implementation of ICT into her pedagogy it is not the only factor that contributed to ICT success.

6.4 Lesson Pace

Before teaching with Open Sankoré Teachers A, B and C expressed that Open Sankoré could assist teachers in speeding up the process of teaching content knowledge to learners. Teachers A, B and C change their stance on the matter after teaching with Open Sankoré. It was evident within the lesson observations that there was no unnecessary teaching time being wasted on repeating where learners should be on the map, or teachers going around to every learner to show them how to use a ruler. This is evident in Smith et al (2006), which also found that using

IWB increased the lesson's pace. It was also highlighted by Hall & Higgins (2005), that the use of IWB increases lesson pace. Even though Open Sankoré could not collaborate with teachers' smartboards it still assisted with learners visibility.

Teacher B mentioned that: *either put the map up on the board and show them which is very time consuming. Now with this software. I have everything on hand. I have a ruler, I have a pencil, I have an eraser, I have a calculator all on one software, so it was a lot easier.*

Here, the teacher had accessible electronic stationary on hand and therefore could show learners how to use them, without walking around the class and trying to attend to every single child. Although the teacher stated that with their laptop the dragging of the applications such as the ruler had a tendency to be slow, this is where learners tended not to be engaged with the software. Large class sizes can negatively affect learners' development of *spatial competence* especially without Open Sankoré. Open Sankoré provides learners with direct accessibility to the topographical or orthophoto map. No matter where they are sitting in the classroom, they can see what the teacher is referring to on the map.

Even though all three participants agreed that Open Sankoré can increase lesson pace, Teacher A highlighted that they lost the learner's engagement because of always having to readjust stationary on the map. This made the process of teaching a calculation slower and learners tended to get bored and do the calculation on their maps before the teacher could finish. Teacher C also highlighted that learners were less engaged because they knew how to calculate the answers already. They were more engaged when the teacher was dealing with bearing, because they were not familiar with that calculation. Due to the fact this was based on revision, learners already knew the content knowledge, and some learners did not need extra support on mapwork skills. However, Teacher A did mention that even though the process was slow, it was still a lot faster than a traditional mapwork lesson because the teacher did not need to walk around and check whether learners were doing the calculation correctly.

Teacher A: *It is difficult when you have thirty children in a class and you cannot go to each one, you do not have the time to show each one there on the map.*

Teaching with Open Sankoré allowed the teacher to access learner's educational needs, even though the teacher was not walking around the classroom now they were teaching. Teacher A also highlighted that the software is diverse, therefore, with stronger classes they can teach

differently as they would with weaker classes. Once again, learner's needs are attended to when mapwork skills are taught with Open Sankoré.

***Teacher A:** I think that's what I like you can change the way you teach as well for each class. You see this isn't working you can go to that you can change it.*

It is evident that Open Sankoré allows the teacher to adapt their lesson pace according to the classes that they have. Hewitt (2009) has also highlighted that teachers are able to adapt lessons according to learners needs with IWB. The same applies here with Open Sankoré, because the software has the same functionality as any other IWB software. The teacher can repeat the processes of mapwork calculations with weaker classes as well as with stronger classes. The teacher can ask learners to do the mapwork calculation on Open Sankoré.

6.5 Training

It is evident within the study that it is essential that there must be training for teachers to incorporate Open Sankoré into teacher's pedagogy effectively. Teacher A highlighted that once the software was introduced, it was overwhelming because it was a new tool that the teacher had never used before, but once the teacher familiarized themselves with it, they found it easy to use. Teacher C also found it user friendly but recognized that they needed to practice with the software.

All three teachers suggested that the training session must focus on showing teachers the basics on how to access certain applications. What was an interesting factor was that all teachers expressed that it is important that teachers practice or "play" around with the software on their own, to incorporate Open Sankoré into their pedagogy successfully.

Teacher B emphasised that training should incorporate a troubleshooting section where teachers are shown what to do if something does not work on the software. This was not included in the initial training session because of an oversight by the researcher. Educational institutions must consider training programs that meet teacher's needs, to support them with ICT integration.

In Teacher B's lesson on distance, the software did not allow the teacher to readjust the ruler on the map. The teacher wasted a significant amount of time trying to fix it and in the interim the learners lost focus. The teacher ended up not using the ruler for the rest of the lesson, due to the technical glitch. The researcher provided some technical support, but it was to no avail.

This was not experienced with Teacher A or C, or with the researcher when they taught with Open Sankoré. It could have been that the laptop that the Teacher B was using was not compatible with the software.

Teachers felt that training can be once-off because the software is user friendly. The researcher tended to disagree with this point because ICTs are constantly changing. New innovations are constantly on the market to improve teaching and learning (Ertmer, 2010). Even in the case of teaching with Open Sankoré there must be regular training sessions so that “teachers can maintain and develop their ICT skills” (Hall & Higgins, p109,2005). Teacher C admitted that she was not well prepared to teach with the software and therefore learners lost interest. This was also evident from the observation that learners were not as attentive as they were in the other lessons where teachers were more prepared with the software.

Researcher: *do you think it has the potential to make mapwork more interesting for learners?*

Teacher C: *It could ... but again it all comes down to me when I'm comfortable with it and when I can figure out to do it properly. I think it was definitely better when I was playing with it with the mouse... not on the touch pad ... So, I think when I'm more comfortable and quicker with it and I don't have to sit and fiddle then they will be more attentive, and they won't be distracted and lose concentration that's why they were talking so much so...*

It is evident within the teacher's answer that if the teacher is not well versed in the technology, teachers and learners will not benefit from the experience. Hewitt (2010) highlighted that teachers that are not ICT competent and incorporate it within their teaching, can lead to the detraction from the learning experience. It is important that teachers attend meaningful training. Regular training sessions will constantly keep geography teachers informed and encourages them to keep using Open Sankoré within their pedagogy. However, it is promising that they did not think that Open Sankoré was a difficult ICT to incorporate within their pedagogy.

Teachers who find ICT difficult to incorporate within their classroom teaching are less likely to use them. Therefore, it is important to have training sessions to encourage teachers to develop their TPCK. It is evident within the study that all participants were not fully comfortable with the software yet, and needed more time to practise. Even though all teachers found it user friendly they felt that they needed to be more confident with the software. This is where training programs can enrich teachers understanding of the software, as well as its affordances.

6.6 Usability and Adaptability of Open Sankoré within Pedagogy

All three participants stated that would use Open Sankoré to teach mapwork skills in the future after this intervention. Teacher C emphasised that they would even teach with it in the senior phases.

***Teacher C:** Even teaching now I could already see where I would be teaching which would be for Grade 10, 11, and 12. So I would definitely use it.*

Out of the three participants Teachers A and B found the software easy to familiarize and adapted it into their teaching. It was evident that Teacher B found the software easily adaptable into her pedagogy, even though she stated that she was not fully comfortable with the software yet, the only way she will teach mapwork from now on is with Open Sankoré.

***Teacher B:** Definitely, I am not going to use anything else (**Laughs**). I'm never going to do it differently. I am going to adapt it now for life.*

One of the main benefits Open Sankoré offered Teacher B was that in the first interview Teacher B expressed that they were not entirely comfortable teaching mapwork skills. In the second interview Teacher B stated that they felt more comfortable teaching mapwork with the software than without it.

***Researcher:** Would you say that the software helped you become a bit more comfortable?*

***Teacher B:** It really has especially with doing co-ordinates. I feel a lot confident in the way I can now teach it and the way how I feel about mapwork because as much as it is a fear for them it was a very big fear for me because I wasn't comfortable in it. I feel a lot better.*

Teacher A highlighted that it is a useful digital tool to guide first year teachers into teaching mapwork skills. This might be true but there is much scope in this study to explore this factor. However, it must be highlighted that Teacher B is a first-year teacher and found the software useful to organize and scaffold knowledge of mapwork skills.

***Teacher A:** But I think if you're a first-year teacher and you teaching co-ordinates, especially co-ordinates. I think this is a wonderful tool.*

Teacher A and B found that Open Sankoré provided structure to their mapwork lessons due to its diversity. Teachers A and B found that their mapwork lessons were more structured and organized within a lesson because they were able to access different applications such as

electronic stationary, from the front of the classroom. Both teachers did not have to walk around to every single learner and therefore it assisted both teachers with discipline. Teacher B claimed that learners were “less rowdy”. Slay (2008) and Hewitt (2010) also reported that teachers using IWB were able to monitor learners better than in traditional lessons.

Open Sankoré especially assisted Teacher B in her teaching methodology to construct a procedural lesson. The training session could have contributed to the development of a structural mapwork lesson, because guidelines were suggested that the teacher could follow. It had been mentioned before, that Teacher B did follow suggested guidelines. Teacher B found the lesson so useful that they would base teaching mapwork concepts on using the software.

***Teacher B:** I really do think it can become a methodology, I really do think it won't just be something that assist me but in what I base teaching mapwork.*

Teacher B's view on adapting Open Sankoré within their methodology was very promising but it is also quite concerning. Teachers must always view technology as a factor that can enhance teaching and learning. In the researchers experiences within the education system, there is a great misconception that, due to the use of technology in classroom, teaching and learning are automatically enhanced. There is no guarantee that this will occur; just as it would be for any other teaching tool. This is the same stance as Hewitt (2010) had, that highlighted that it is not about what resources or digital tools are used but the way they are used that enhances the teaching or the learning process.

Teachers should view ICTs as an element that can assist them in reaching their teaching and learning outcomes. The ICT should not be viewed as the teaching and learning outcome. If teacher's view technology as a resource that can deliver their teaching and learning outcomes, there will be no real purpose in using the technology. “Teachers’ uses of technology are rarely linked to the student learning outcomes they are designed to facilitate” (Ertmer, 2010, p 257). In Teacher B's answer Open Sankoré had become the core of their mapwork lessons. In this situation, the teacher may lose the purpose of why they are using the technology in the first place. “the presence of technology dominates and that could lead to the teacher being inflexible and confining classroom conversation to the content on the technology” (Ndlovu, 2015, p37). The teacher could be so fixated with Open Sankoré that the teacher could be disadvantaging themselves from applying other useful methods to their pedagogy that could also develop *spatial competence*.

Teacher C however had the opposite view of Open Sankoré being adapted as a methodology within the field of mapwork skills. Teacher C emphasised that Open Sankoré must be used as a blended learning tool. The teacher stated that they would still use their traditional methodologies of how they teach mapwork and simply incorporate Open Sankoré along with these teaching tools. Teacher C did admit that they needed more practice and time with the software, and this may have contributed to the teaching seeming to have less potential in the software than with the other two participants.

***Teacher C:** No, I still think I can use it while I'm teaching uhm, instead of saying to the children please look for this spot height and it's a north easterly direction... now all I would do say this is where the spot height is ... look for it. I would still then use my board and ... do all my calculations on the board ... So, I will work with it together.*

The diversity of Open Sankoré also contributed positively to the adaptability within teacher's methodology. All three teachers found value in accessing different applications that assisted their teaching, such as rulers, protractors and other types of orthophotos and topographical maps. These multimodal texts assisted the teachers in mediating mapwork concepts to learners more easily than they would in a traditional mapwork lesson. Teacher A also found that the software made it easier to introduce new mapwork concepts. The researcher also found that the more the observations, and the more applications were used on the program the more intrigued learners were. Teacher C used the calculator during the lesson, which learners expressed enthusiasm about, even though Teacher C's class was not as engaged as were the other participants classes when the teacher used the calculator.

***Researcher:** Do you think it encourages discussions outside the classroom? So, do you think the learners went away and they talked about it more?*

***Teacher C:** Oh yeah ... the calculator one was blowing their mind that it was there.*

However, all participants found a few elements within the software that they did struggle with. The first was that all participants had to use a mouse to navigate the software. It was too difficult to navigate the software with a touch pad on the laptop.

***Teacher C:** I think it was definitely better when I was playing with it with the mouse ... not on the touch pad ...*

Teacher C also found it frustrating once the teacher had put the ruler on a specific area as well as the magnifier that they could not readjust the ruler once the magnifier was on it. Alternatively, the teacher could have used the zoom in and out function, but the teacher also found this option too slow in zooming in and out of the map. Teacher C was not familiar with the software and this could have contributed to the teacher not being able to manoeuvre with the software effectively. Teachers A and B also found zooming in and out slow, but they were able to manoeuvre the mouse to speed the process up. In some instances, zooming in and out does tend to lag but this is because the scanned map images were larger than the other smaller images. the software did not lag when zooming in and out.

Teachers A and B found that they always had to re-adjust the stationary on the map which teachers found time consuming and they lost some momentum within the lesson. Teacher A specifically highlighted that their Grade 8's had lost focus of what the teacher was doing on the board and started doing the calculation on their own. This may be because the lessons were based on knowledge that was previously taught, and learners already knew what to do. The researcher also found that it was not necessarily a bad thing that learners started doing calculations on their own. Innes (2009) stated that to develop *spatial competence*, learners had to be able to work individually and at their own pace. As result, learner agency was expressed within the lesson because the learners felt confident enough to go ahead of the teacher. Learners had recognized within their own cognitive maps what the next step was within the calculation. It would be interesting to investigate if the learners that went ahead of the teacher did the calculation correctly but that is not in the scope of the study.

6.7 Differences in Learning Environment

All participants in the study recognized that the accessibility of the map was improved by teaching with Open Sankoré. Innes (2012) highlighted that it is incredibly difficult to teach learners mapwork skills if there are no maps that teachers and learners can work from.

Teachers A and B found that the software assisted them in providing more clarity to learners on co-ordinates. Teacher A explained why they found the software to be useful to teach co-ordinates:

Teacher A: *because you can actually say go here, go to the top, bottom top before you even go towards North and South. You can just say bottom, top, bottom, top. They can see it and look at it and then they can look at their map and see the same thing, so I do think it helps.*

Teacher C taught different lessons to Teacher A and B and they thought that Open Sankoré would be helpful in teaching landforms and contour lines. This was because learners can physically see these landforms, especially on an Orthophoto, which Teacher C was using in their lesson.

Teacher C: *land forms or something like that and you must focus on the contour lines using the magnifier and you actually show them then maybe that will help them a lot.*

In both examples teachers explained how Open Sankoré could improve the visibility of geographic concepts within lessons. It was observed in Teachers A and B's lesson that both classes did not understand the concept of co-ordinates. Towards the end of these lessons learners were able to do calculations on their own and give the teacher the correct answers. As a result, this may have benefited learners in conceptualizing these concepts within their cognitive maps. It must be highlighted that this is an assumption based on observations because it cannot be clear what is happening within the learner's cognitive map.

Teacher A: *Yes, I think a lot of the time in the beginning they were a bit "iffy, iffy, iffy" and at the end when we went through it again there was much more clarity. Even with 8Z, it was a very rocky start (laughs) but at least they got it. They at least knew what to do.*

Here, the teacher has emphasised that while the learners were being taught with Open Sankoré, concepts had become clearer for learners to understand. Teacher B also found that both their classes understood co-ordinates and distance better using Open Sankoré. Open Sankoré can contribute to the better understanding of concepts due to strong visual images, therefore making mapwork concepts that are considered abstract knowledge bases more concrete. Because this was revision, some learners seemed to lack engagement, but even though it was revision, based on the observations, most learners were attentive during lessons.

However, Smith et al., (2005) does consider that it is not guaranteed that learners understanding of content knowledge is improved by including visual resources. It is dependent on how the teacher presents these visuals to learners that is important. Greiffenhagen (2002) discusses that in mathematics it is vital to draw mathematically in shapes, due to "direct manipulation pertinent to understanding the properties of a shape" (Smith, 2005, p97). It is evident that appropriate visual resources play an important part in assisting teachers to mediate knowledge to learners.

Teachers A and B found that with weaker classes they were more engaged with the ICT than

with classes that understood content knowledge. This correlates with Smith et al., (2006), who, stated that primary school children that struggled with reading and writing were more engaged in lessons when the IWB was being used.

Teacher A: *“also think this was great with your weaker classes if you look at 8Z, they were glued to the screen even though we done it for a few months they were still glued to ...looking at the screen ... looking at the screen ... looking at the screen ... looking at the screen and following it.”*

It is evident especially with weaker classes that Open Sankoré created a learning environment where learners were engaged with content knowledge. On the other hand, stronger classes tended to lose interest because they already knew what to do, even though learners were less engaged on what was being done on the board. They were more engaged with their physical map, therefore they were still engaged in the mapwork lesson.

Open Sankoré also provided a platform for learners who are scared to ask questions in class but were still able to engage with content knowledge on Open Sankoré, because it provides better visibility of the map. Teachers A and C also catered for these learners, because they utilized group work in conjunction with the ICT. Teacher C emphasised that Open Sankoré assisted learners in collaborating with one another. It is evident, through the analysis of media forms that Open Sankoré did assist learners with discussions about content knowledge. It must be mentioned that Open Sankoré did not necessarily encourage group work, but it did aid discussions within learner groups. Teacher C found that the software assisted with collaboration between learners, and with discussing the questions and content knowledge.

6.8 Limitations of Open Sankoré

To have a sound understanding of the value of an ICT within the teaching and learning environment, it is important to recognise its limitations. This will inform trainers, teachers and students what to be aware of when using Open Sankoré, to improve the teaching and learning experience. It will also provide a better understanding of its full capabilities as a learning tool.

Scanned map images:

- Scanned map images are large and therefore zooming in and out functions tend to lag.

- The original Topographical and Orthophoto maps are scanned images from the original map and therefore the original scale is distorted, and distance calculations are off by 0,2-0,4 centimetres.
- Maps cannot be on a touch screen because Open Sankoré does not collaborate with Parrot Smartboards.

Electronic stationary:

- Re-adjusting of electronic stationary may also lag while teaching.
- You cannot use a magnifying glass in conjunction with electronic stationary.
- The use of the magnifying tool can also distort scale.

Geographic knowledge:

- Learners' lack of knowledge of conventional signs of a general map disadvantages learners in the reading of the map, even if the teacher is showing them where to look on the board.

6.9 Summary of the Findings

Open Sankoré added pedagogical value within the specific media forms that teachers used the software in, to teach mapwork skills. Open Sankoré was also able to encourage Geographical practices amongst learners. These practices were described in the 21st Century road map which provided more pedagogical value of Open Sankoré within the realms of the Geography. It was found that the more complex the media form was, the more geographic practices it encouraged.

Teachers found that Open Sankoré was user friendly and was easily adaptable into their pedagogy. Teachers found that generally Open Sankoré increased lesson pace. Teachers that taught with Open Sankoré and used blended learning, such as using the whiteboard in conjunction with Open Sankoré, were the more experienced teachers. The more functions the teacher's used on the software during the lesson, the more interested, learners were in the software. Teachers found that there was more clarity of mapwork concepts amongst weaker learners. Lessons that had linked the map, the mind and the real world provided more clarity of mapwork concepts.

The study found that teacher training plays an important role in the successful integration of Open Sankoré. The training encouraged teachers to think about the affordances of the software. The training informed teachers' attitudes and perceptions of Open Sankoré. The training must

be meaningful where it meets teacher's expectations as well as their teaching and learning goals. There was also a realization within the study, that the implementation of ICT within teacher's pedagogy is also dependent on teacher's initiative and willingness to practise and learn.

Chapter 7: Conclusion

7.1 Introduction

This chapter is focused on establishing a conclusion to the argument on the pedagogical value of Open Sankoré in teaching mapwork skills. The conceptual tool assisted the research in answering the four research questions. The conceptual framework provided a structural integration of frameworks that assisted with the development of mapwork skills and the integration of ICT. The conceptual framework assisted the research in understanding the usefulness of teaching with Open Sankoré; for teaching mapwork skills by organizing data within the realms of these frameworks, to produce a conclusion. A detailed explanation of the conceptual framework is provided in Chapter 3.

The three main research questions are:

1. How can the use of Open Sankoré support teachers' pedagogical needs to teach mapwork skills effectively in Grade 8 and 9 classrooms?
2. What are teachers' perceptions on teaching mapwork with Open Sankoré?
3. What functionality of Open Sankoré has enhanced the teaching of mapwork in Grade 8 and 9 Social Science?

7.2 How can the use of Open Sankoré Support Teachers' Pedagogical Needs to Teach Mapwork Skills?

Improved accessibility and visibility of the map

Innes (2009) has emphasised that maps contain important information about the real world around us. People that cannot access or read maps are at a major disadvantage because they cannot be involved in the decisions of the community. Maps are an important resource to have when developing *spatial competence*. Innes (2009) states that cartographic map concretizes geographic concepts within cognitive maps. This enables expansion of the cognitive map by mediating new geographic concepts within the cognitive map. It is obvious that the cartographic map is a vital factor in developing *spatial competence*.

Open Sankoré provided teachers and learners improved accessibility to the Topographic map, as well as the Orthophoto. All learners were able to engage with the map on the board if learners couldn't understand what the teachers was referring to. It was evident within all seven lessons that the learners did not ask what area the teacher was referring to on the map. Therefore,

learner's map orientation also improved. According to Innes (2009), improved accessibility and visibility of the map can improve teachers' and learner's *spatial competence*.

Improved accessibility and visibility of mapwork stationary

Innes (2009) found that teachers at under-resourced schools did not have adequate resources to teach mapwork skills. In Innes (2009) study, it was stated that some learners could not afford to buy mapwork stationary such as rulers and protractors.

Open Sankoré assisted learners to understand how to use mapwork stationary, even if they did not have their own mapwork stationary. The projection of Open Sankoré onto the board let learners see what processes to follow when they used a ruler or protractor in a mapwork calculation. This also showed learner's the accuracy that is involved with mapwork calculations. In traditional mapwork lessons teachers must either verbally describe how stationary is used or they hold up stationary, which is difficult for learners to see, especially in larger classrooms.

Support of Open Sankoré for learning processes within the CF

The study found that the teacher's use of Open Sankoré was in the Narrative, Interactive and Collaborative phases. It was found within the study that Open Sankoré mostly supported three out of the four learning processes namely discursive, interactive and adaptive. This was not only using the ICT on its own, but also showed how the teacher used the ICT to mediate knowledge that supported these learning processes. It must be taken into consideration that: "not so much what resources or tools an educator has at his/her disposal, but how these resources or tools are used to create the most positive learning experience" (Hewitt, 2010, p 12). The teacher is also responsible for how the ICT is used to support the learning processes (Ndlovu, 2015).

Open Sankoré and the teacher supported learning processes in the CF in the following ways:

- a) **Discursive:** Teacher's explained and described mapwork calculations such as co-ordinates, distance, direction and bearing to learners by showing them on the software.
- b) **Interactive:** Teachers were continually asking for verbal feedback from learners, while teachers were engaging with the software. Feedback was also expressed through mapwork activities.

- c) **Adaptive:** Learners integrated new knowledge by re-adjusting their cognitive map by getting teachers to show them the correct mapwork procedure on the board. The learners then applied this knowledge to the mapwork activities, which was done individually or in groups.
- d) **Reflective:** Learners can reflect on knowledge of mapwork skills by watching what the teacher is doing in relation to co-ordinates, distance, direction and bearing and reflecting to their own knowledge.

Support of Geographic practices

Open Sankoré was found to support all six geographic practices. Although teachers were the main users of the software, it still managed to support all six practices. Once again, it must be stressed that it was not only the ICT that contributed to this, but also how the teacher used the software that supported these practices. Open Sankoré and the teacher supported these practices in the following ways:

- a) **Posing Geographic Questions:** While the teacher was showing learners how to do specific mapwork calculations on the board learners would synthesize information on the map and ask the teacher a question relating to the map. This was also done during individual or group work, where learners had to apply their knowledge to the map and thus geographic questions were formulated.
- b) **Acquiring Geographic Information:** While teachers were explaining mapwork concepts such as distance, direction, bearing and co-ordinates to learners, they were internalizing geographic content knowledge while the teacher was engaging with the map on Open Sankoré.
- c) **Organizing Geographic Information:** While learners were doing a certain mapwork calculation learners had to do it in steps whether they were working on their own, with their group or with the teacher. The learners had to synthesize mapwork concepts and organize them within their cognitive maps, to do the calculation correctly. When the teacher asked the learners “what do I do now?” is a good example of how learners had to organize geographic information within a mapwork calculation.
- d) **Analysing Geographic Information:** During mapwork activities learners had to find certain places on the map to do the calculation. The learners could choose whether to search for these location on the map that was displayed on the board, or on their own map. Therefore, learners were analysing the map with their own geographic knowledge

and applying their knowledge to do mapwork calculations. During mapwork activities learners also had to choose which mapwork calculation would suit the specific case study, to find an answer.

- e) **Answering Questions/Designing Solutions:** During the use of Open Sankoré, teachers constantly asked learners a variety of questions that related to the map.
- f) **Communicating Geographic Information:** Constant interaction between teachers and learners about mapwork skills can stem from asking questions or having group discussions about content knowledge.

Supported concepts of GIS

Geographic Information Systems (GIS) have become prominent within the Geographic field. Due to the vast growth of technology worldwide, it has been incorporated into the realm of mapwork. Innes (2009) values GIS because it provides a platform for “Displaying and manipulating local maps and maps of other areas in ways that will stimulate learners to explore their own environment and to investigate issues of both local and general concern” (Innes, 2009, p57). It is important for Geography teachers to be aware of programmes that can display GIS concepts for learners.

Scanned maps are used to teach Mapwork lessons with Open Sankoré. The presence of digital Topographical maps and Orthophotos can support these concepts of Geographical Information Systems. Open Sankoré has applications that can layer and manipulate these maps. Applications such as google maps can be accessed on Open Sankoré, therefore teachers can show learners different aspects as well as being able to pinpoint certain locations. Teachers can also use different shapes and different colours to represent different types of layering on the map. There is also associability to the zooming in and out function, as well as the magnifier that can show the concept of high and low resolution on Topographical maps or Orthophotos.

7.3 What are teachers’ perceptions on teaching mapwork using Open Sankoré?

All participants in the study said that they would use Open Sankoré in future instances to teach mapwork skills. Teachers’ perceptions of the program were positive on incorporating it into their pedagogy. There was also interest in using the program in the Grade 10, 11 and 12 phases. There was a general perception that Open Sankoré did indeed make mapwork lessons easier to teach. Mueller et al., (2008) referred to: “positive experiences with computers in the classroom context that build a teacher’s belief in computer technology and confidence in its potential as an instructional tool” (Ertmer, 2010, p261). This is a positive result for the study, because if

teachers have a positive attitude towards teaching with Open Sankoré, it is more likely that they will incorporate it within their methodology. A contribution to these positive attitudes is that teachers did not find it particularly difficult to incorporate the software into their pedagogy. However, participants did express that they were not fully confident with the software yet. This is where continuous training contributes to the successful implementation of a digital tool. Facilitators must make sure that training sessions meet teacher's needs for training to be meaningful and worthwhile, for Geography teachers.

7.4 What functionality of Open Sankoré has enhanced the teaching of mapwork in Grades 8 and 9 Social Science?

There were several tools that teachers used that made the mediation of mapwork concepts for teachers easier: (Screenshots of these functionalities can be found in Chapter 5).

- **The zoom in and out function or the magnifier:** The teacher was able to focus on the specific area on the map they were referring to.
- **Straight Line or Pencil:** The teacher was able to circle specific conventional signs. Showing learners specific co-ordinates and how to divide the map into either minutes or seconds.
- **Pointer/Highlighter:** The teacher could also highlight or circle specific conventional signs or co-ordinates.
- **Ruler/Protractor:** The teacher could show learners how to use the electronic stationary on the Topographical map or Orthophoto. Measurement on the protractor is on the inside on Open Sankoré. Learners are used to the measurements outside of the protractor. This enables learners to apply knowledge in a different way.
- **Colour changes:** Teachers could change colours of specific lines. This was particularly useful for co-ordinates.
- **Calculator:** Teacher could show learners exactly what to plug into their calculators. This was particularly useful for the gradient formula.

7.5 Recommendations for Successful Integration of Open Sankoré

There has been a positive reaction to integrating Open Sankoré as a digital tool, to teach mapwork skills within the Social Sciences. For successful implementation of Open Sankoré within Geography departments, the following recommendations should be considered. These recommendations were brought to researcher's attention during the research process:

There was a concern that the software did not reach its full teaching and learning capabilities within the study. Unfortunately, two teachers that participated in the study only had projectors and whiteboards in their classrooms. There was one participant that did have a Parrot smartboard, but Open Sankoré did not collaborate. Therefore, the software was only projected onto the board. For the software to be more interactive, teachers must be exposed to a touch screen where the teacher can work on the IWB. The software collaborates with Microsoft Surface Hub, Apple TV, Samsung Tables. These ICTs will be able to support Open Sankoré to be more interactive, collaborative and productive within the media forms. To encourage these media forms learners must have access to the appropriate software.

Teachers must have a knowledge of the functionality of the software, before teaching. Teachers waste unnecessary teaching time when they do not know where to find applications. Therefore, a sufficient amount of time must be given to teachers to practise with the software before teaching with Open Sankoré, to build their confidence.

The teacher training session must also be adjusted to suit teacher's needs. There was no section where teachers dealt with troubleshooting and technical difficulties with the software. In Ndlovu (2015), teachers wanted ideal training sessions to prepare for the “workshop namely: facilitator competence and attitude or behaviour; school support and provisioning of continuous PTD; training contexts that are conducive to productive learning” (Ndlovu, 2015, p11). To have a worthwhile and meaningful training sessions in the future for Open Sankoré the above factors must be considered.

Teachers were taught with scanned maps which were provided by the researcher. Scanning of individual maps becomes expensive. Geography departments should consider buying digital topographical maps as a package. South African digital maps can be found on the following website at a reasonable cost: www.mapstudio.co.za. Teachers must check the contrast of the maps on their whiteboards before teaching. Orthophoto maps tend to be too dark, therefore the contrast must be adjusted.

7.6 Limitation to the Study

It was difficult to rate the understanding of learners within the classroom, because it is difficult to access the learners cognitive map from the external environment. Kaplin in Innes (2009) stated that “assessing cognitive maps is problematic in that they cannot be evaluated in terms of what the investigator can assess via language use, but rather in terms of the validity of the

map, as a guide to the subject in whose head it resides” (Innes, 2009, p40). Kaplin suggested that to access the cognitive map, teachers must assess the learners’ understanding of the map itself. It is still very difficult to gauge how the learners’ cognitive map is constructed. It was also difficult to gauge whether the cognitive map was indeed accessed based on what is in the learner’s mind. Assumptions can only be made based on the learner’s understanding of mapwork concepts.

The scope of the research was too small to generalize about Open Sankoré for Geography Departments all over South Africa. Nevertheless, this study has given researchers an outline of what Open Sankoré has to offer as a digital tool to teach mapwork skills.

As mentioned before the full potential of Open Sankoré could not be explored. Firstly, because the learners did not have direct access to the software to do mapwork calculations. Secondly, the software was merely projected onto the whiteboard. Many theorists such as Smith, Higgins, Slay and Hewitt would say that the ICT had lost its interactivity; but there have been many examples within the research that say otherwise. Even though the full potential could not be explored, many positive attributes were found within the software.

7.7 Proposal for Further Study

The study has identified many benefits to teaching mapwork skills with Open Sankoré, but what should also be identified is the impact that it has on learners. There is much interest in finding out whether learners are more engaged and motivated to learn mapwork skills. It would be interesting to investigate whether Open Sankoré irradiates the “mental block,” learners have when being taught mapwork skills.

7.8 Final Conclusion

Innes (2009) *spatial competence* as well as Laurillard (2002) media forms and Conole and van Dyke’s Taxonomy of ICT have contributed to showing that Open Sankoré does have pedagogical value in teaching mapwork skills. These frameworks have assisted the study to understand how Open Sankoré has enhanced teacher’s pedagogy to teach mapwork skills. As much as Open Sankoré provides a small solace to teacher’s frustrations with mapwork, it is imperative that teachers’ *spatial competence* is well developed. This cannot be fixed by introducing a digital tool within their pedagogy. There must be adequate training that serves teacher’s needs, not only for the digital tool itself, but also to provide subject knowledge support in mapwork skills. The research also found that it is essential that teachers are willing

and prepared to incorporate Open Sankoré into their pedagogy. However, if this is not the case the digital tool will lose its effectiveness for teaching mapwork skills.

Appendix A

Clarification of terms:

- a) **Artificial features:** These features are human-made. People have taken responsibility for building these features to improve quality of life. An example is a city.
- b) **Blended learning:** Teachers using traditional teaching along with ICTs.
- c) **Conventional map signs:** Symbols that represent real life objects on a topographical map.
- d) **Graphical skills:** The ability to interpret and analyse visual data.
- e) **Interactive Smartboard Software:** This software is used in conjunction with smartboards within the classroom. This software has digital stationery such as a ruler, and a protractor so as to teach mapwork more efficiently.
- f) **Land forms:** These are features that are developed naturally by processes such as erosion, weathering or movement of the Earth's crust. An example would be a river.
- g) **Map literacy:** Skills that are required to read and interpret a map, regardless of what type of map it is.
- h) **MapTrix:** Mapwork board game that Innes developed in 1998.
- i) **MapTrix Geomatica:** A digital version of the board game MapTrix
- j) **Natural features:** These are features that have naturally developed on Earth. For example, geological and weathering processes, as well as natural vegetation.
- k) **Orthophoto map:** This is a combination map and photograph of an area and uses the scale of 1cm on the map = 10 000 cm in real life. Geographers use this map to make topographical maps of an area. Learners must use orthophoto maps in conjunction with topographical maps. This enables learners to develop the skills of seeing content knowledge in a different context, while working with different sources. It also assists learners to develop skills of adapting a scale to a map.
- l) **Spatial behaviour:** An individual's actions in relation to spatial data.
- m) **Spatial competence:** The ability to interpret and analyse spatial data.

- n) **Spatial differences:** Are the variance of an area in distance, shape or dimension.
- o) **Spatial intelligence:** The ability to organise information spatially.
- p) **Topographical map:** This is a map that uses various types of symbols to indicate different artificial and natural features in a specific area, which would be on the map. The scale of Topographical maps as commonly used in South African schools is 1:50 000. (One cm on the map represents 50 000 cm or 0.5 km on the ground in real life).

Appendix B

Abbreviations:

- a) AIW - Authentic Intellectual Work.
- b) CAPS - Curriculum and Assessment Policy Statement.
- c) CF - Conversational Framework.
- d) DBE - Department of Basic Education.
- e) FET- Further education and Training.
- f) ICT - Information Computer Technology. These are learning tools or platforms that incorporate all types of technology to assist teaching a particular topic. They enhance learning experiences and learners gain technological skills within the classroom.
- g) IWB - Interactive whiteboard. This is a digital blackboard within the classroom.
- h) OS - Open Sankoré.
- i) PCK - Pedagogical Content Knowledge.
- j) TPACK - Technological Pedagogical and Content Knowledge.

Appendix C

Lesson Guidelines:

Lesson Focus: Distance (50 Minutes)

(Bear in mind these are only suggestions)

- Start with scale
 - Show learners the different scales on the map using the software
 - Line scale: (Located at the bottom of the map)
 - Explain what the line scale is: This is to get an estimation of a real distance
 - Show learners how you would use line scale
 - Measure with a ruler point A-B put the ruler on the line scale (Show this with the software)
 - Ratio Scale: Gives an accurate measurement
 - Ask learners what the ratio scale represents
 - Why do we X 0,5 km to get a real-life measurement
 - Do two examples with learners
1. Using the lines scale measure from Spot height 625 (15) to Spot 582 (H14)

±2,8 KMs
 2. Find the distance from the diggings (H15) to the wind pump (J13)
 3. Find the distance from Little Muck (B15) to Lareve (I15)

Case studies

1. Mapungubwe is a very dry area where there is very little water. What is the distance to the nearest dam to Breslaw (M15) in meters.

Answer: $1,6 \text{ cm} \times 0,5 = 0,8 \text{ Km} \times 1000 = 800 \text{ m}$
2. An aeroplane has made an emergency landing at the landing strip in (A15). One of the wheels of the plane has broken off. The landing strip does not have supplies. What is the distance to the nearest landing strip?

Answer: 21, 1cm X 0,5 = 10, 55 Km

3. An old diamond mine used to transport diamonds to the nearest town of Mapesu. How far did the diamonds have to travel to get to Mapesu safely?

Answer: 5,5 cm X 0,5 = 2,75 Km

Lesson Focus: Co-ordinates (50 Minutes)
(Bear in mind these are only suggestions)

- Teach co-ordinates from scratch. Pretend that learners have never been taught this before.
- Talk about the four main cardinal points (Refer to the map of Mapungubwe which will be on the board) North, East, South, West.
- Co-ordinates are based on where locations lie in relation to the Equator and Greenwich Meridian.
- Help pin-point a certain location.
- **Lines of latitude:** These lines show North and South. (Show a line of latitude on the software).
- **Ask learners:** Where does Mapungubwe lie in relation to the equator?
- **Lines of longitude:** These lines show East and West. (Show a line of longitude on the software).
- **Ask learners:** Where does Mapungubwe lie in relation to the Greenwich Meridian?

Degrees: Bigger unit of measure

- Explain what degrees are (I like to explain it, I use pizza as an example: 1 whole pizza is a degree).
- Why are they there? (Pin-point direction).
- Explain $1^{\circ} = 60'$.
- Show what the degrees are on the map.

Minutes: Smaller Unit of measure

- Explain what minutes are. (This is one slice of pizza).

- Explain that every line on the map represents 1' (refer to the software here)
- OPTIONAL: Write the minutes on the software

If this takes too long do the first few and then let the learners call out to you.

Do two or three examples with learners with the software

1. Spot height 603 (D1)
2. School (F8)
3. Jarukanga (Irrigation Project) (C6)

Answers:

1. $22^{\circ} 00' \text{ S}; 29^{\circ} 18' \text{ E}$
2. $22^{\circ} 07' \text{ S}; 29^{\circ} 20' \text{ E}$
3. $22^{\circ} 05' \text{ S}; 29^{\circ} 17' \text{ E}$

Case Studies

1. An Aeroplane needs to make an emergency landing because it has run out of fuel. You are at the control centre and you need to give places on the map where the pilot can land.

a) Landing Strip (D7):

Answer: $22^{\circ} 07' \text{ S}; 29^{\circ} 19' \text{ E}$

b) Landing Strip (A15)

Answer: $22^{\circ} 14' \text{ S}; 29^{\circ} 15' \text{ E}$

2. You are planning an end of year party at Schroda Dam. What co-ordinates would you put on the invitation for guests to arrive at the right place?

Answer: $22^{\circ} 11' \text{ S}; 29^{\circ} 26' \text{ E}$

3. There is an annual walk that takes place every year in July at Vhembe/Dongola. The starting point is at Spot Height 573 (N14). What co-ordinates would you email to people who want to join the walk?

Answer: 22° 13' S; 29° 28' E

Lesson Focus: Grade 9 Aerial Photographs (50 Minutes)
(Bear in mind that these are only suggestions)

Aerial photographs

- Explain what an Orthophoto map is?
- Why are Orthophoto maps important? (Can use an area on the map, dam, farm, buildings)
- The different aerial photographs (Vertical, High oblique, Low Oblique)
- Show that the Orthophoto is an example of a vertical aerial photograph? (Show this on the software. You can access google maps, satellite or street view).
- Show learners the different elements on a Orthophoto (Ratio, contour lines, spot heights).
- Look at some features on the map to show learners how to identify them.
- E.g.: Airport, Stadiums, Roads, Cemetery, residential area (Zoom in onto these features on the software).

Direction

Explain the importance of direction.

Why Geographers use direction.

Discuss 16 cardinal points (Use the software to make a compass)

Clear screen and go through two examples with learners, using the software. (Use the software)

1. Find the direction from Westbourne Oval to George's Park.

Answer: SSE

2. Find the direction to Boet Erasmus Stadium from Port Elizabeth Airport.

Answer: ENE

Bearing

Explain the importance of Bearing.

Why Geographers use Bearing.

Use the protractor on the software to explain to learners how to place the protractor to work out bearing.

Go through two examples with learners.

1. Find the bearing from Donkin Reserve & Pyramids to Port Fredrick Monument.

Answer: 169°

2. Find the Bearing from Albany Road interchange to Russel Road interchange.

Answer: 57°

This can be done on groups or individually.

Learners must do examples on their own.

Find the direction and bearing of the following:

Show learners where these features are on the software:

1. From King's Beach to Beach Road
2. To Forest Hill Cemetery from Hoy
3. From Charl Malan Kaai to Nr 3 Kaai
4. From Humeraii to Craig Bain
5. To Fair Haven from Humewood
6. From Trig Beacon 462 to Spot height 59

Answers:

1. SSW 195°
2. ESE 105°
3. SSE 155°
4. WNW 300°

5. SW 199°

6. NW 149°

Lesson Focus: Co-ordinates (50 Minutes)
(Bear in mind these are only suggestions)

- Teach co-ordinates from scratch pretend learners have never been taught this before.
- Talk about the four main cardinal points (Refer to the map of PE which will be on the board) North, East, South, West.
- Co-ordinates are based on where locations lie in relation to the Equator and Greenwich Meridian.
- Help pin-point a certain location.
- **Lines of latitude:** These lines show North and South. (Show a line of latitude on the software).
- **Ask learners:** Where does Port Elizabeth lie in relation to the equator?
- **Lines of longitude:** These lines show North and South. (Show a line of longitude on the software).
- **Ask learners:** Where does Port Elizabeth lie in relation to the Greenwich Meridian?

Degrees: Bigger unit of measure

- Explain what degrees are? (I like to explain it, I use pizza as an example: 1 whole pizza is a degree).
- Why are they there? (Pin-point direction).
- Explain $1^{\circ} = 60'$.
- Show what the degrees are on the map.

Minutes: Smaller Unit of measure

- Explain what minutes are? (This is one slice of pizza)
- Explain that every line on the map represents 1' (refer to the software here)

Seconds: Smallest unit of measure

- Explain what seconds are (This is 1 slice is cut up into 60'')

- (Refer to a block on the map on the software)
- OPTIONAL: Write the minutes on the software

If this takes too long do the first few and let the learners call out with you.

Do two- three examples with learners with the software:

Easy to difficult:

2. Recreational Centre (C1)

Answers: $33^{\circ} 51' 39''$ S; $25^{\circ} 31' 32''$ E

2. Spot Height 123(L4)

Answers: $34^{\circ} 00' 42''$ S; $25^{\circ} 34' 4''$ E

3. Trig. Beacon 436 (M9)

Answers: $34^{\circ} 01' 25''$ S; $25^{\circ} 38' 44''$ E

This can be done in groups or individually: (Walk around class and assist learners)

Case Studies: Zoom in to the bottom half of the map.

- A. There is a Golf tournament that is happening this Saturday at Walmer Golf Course. There are players that are coming from all over the country. In order for players to know where to go; as the organisers we must put the co-ordinates on the invitation. What would these co-ordinates be?

After giving the learners a few minutes to work it out do it on the software with them:

Answer: $33^{\circ} 59' 42''$ S; $25^{\circ} 33' 47''$ E

- B. What other Golf Course could be used for the event?

Answers: I5- $33^{\circ} 59' 31''$ S; $25^{\circ} 35' 00''$ E

J4- $33^{\circ} 58' 27''$ S; $25^{\circ} 34' 25''$ E

K7- $33^{\circ} 59' 8''$ S; $25^{\circ} 37' 23''$ E

L10- $34^{\circ} 00' 14''$ S; $25^{\circ} 40' 53''$ E

- C. Which Golf course would be better to use for the event? Humewood because it is larger.

2. The University is running an open-day to attract Grade 12 students to apply to their University. What should be on the email that should be sent out to students?

Answer: $34^{\circ} 00' 36''$ S; $25^{\circ} 40' 8''$ E

3. A. The children's holiday centre is having a Spring Party on the 1st of September. What would be the co-ordinates that the moms would have to plug into their GPSs?

Answer: $34^{\circ} 02' 55''$ S; $25^{\circ} 35' 8''$ E

- B. At what other facility near the children's holiday centre can there be a Spring Party. And give the co-ordinates?

Answer: Swimming Pool: $34^{\circ} 02' 50''$ S; $25^{\circ} 36' 30''$

Appendix D

Interview Schedules:

First interview schedule before the teacher teaches with Open Sankoré

Topic 1.1: General Information.

1.1.1. How long have you been teaching, Social Sciences?

1.1.2. What type of teaching qualifications do you have?

1.1.3. What Grades do you normally teach?

1.1.4. Which grade do you prefer teaching? Explain why is this so?

Topic 1.2: Teaching of mapwork in the teacher's classroom

1.2.1. Do you enjoy teaching mapwork? Explain why you say so. (A discussion may arise from this question)

1.2.2 What do you find is the most difficult to teach in mapwork in the Grade 8 and 9 curricula?

1.2.3 What is your approach or philosophy on teaching mapwork - what are methods that you have used in the past that have worked or have not worked?

Interview schedule 2: This interview will be conducted after teachers have been observed with Open Sankoré.

Topic 2.1 Usefulness of teaching with Open Sankoré

2.1.1 Did you find the smartboard Open Sankoré software user friendly?

2.1.2 What did you find was problematic about the software in relation to teaching map work?

2.1.3. What did you find was useful about the software in relation to teaching map work?

2.1.4. Do you think this will make teaching of mapwork easier or harder? Teachers must provide reasons for their answers.

2.1.5. Did Open Sankoré assist in eradicating difficulties that you experienced when teaching mapwork?

2.1.6 Do you think that Open Sankoré made your teaching experience easier or more difficult?

2.1.7 Do you think that extensive training must be provided to adapt this digital technique to teaching?

2.1.8 Would you use Open Sankoré to teach mapwork in your class in future instances?

2.1.9 Has Open Sankoré changed your attitude towards teaching mapwork skills?

Topic 2.2 pedagogical value of Open Sankoré to the learners

2.2.1 How do you think learners reacted to teaching with Open Sankoré? Positively/ Negative explain the reason for your answer.

2.2.2 Did you find that learners had more clarity of concepts during the lesson?

2.2.3 Were most learners more attentive during the lesson?

2.2.4 Did you think that Open Sankoré appeals to all learners in the classroom?

Appendix E

Ethics committee approval and GDE approval letters:

Wits School of Education



27 St Andrews Road, Parktown, Johannesburg, 2193 Private Bag 3, Wits 2050, South Africa.
Tel: +27 11 717-3064 Fax: +27 11 717-3100 E-mail: enquiries@educ.wits.ac.za Website:
www.wits.ac.za

24 May 2017

Protocol Number: 2017ECE011M

Student number: 458945

Dear Ines De Almeida

Application for ethics clearance: Master of Education

Thank you very much for your ethics application. The Ethics Committee in Education of the Faculty of Humanities, acting on behalf of the Senate, has considered your application for ethics clearance for your proposal entitled:

The Pedagogical Value of Open Sankoré in Teaching Mapwork Skills to Grade 8 and 9 Learners in a South African Public School

The committee recently met and I am pleased to inform you that **clearance was granted**.

Please use the above protocol number in all correspondence to the relevant research parties (schools, parents, learners etc.) and include it in your research report or project on the title page.

The Protocol Number above should be submitted to the Graduate Studies in Education Committee upon submission of your final research report.

All the best with your research project.

Yours sincerely,

A handwritten signature in black ink, appearing to read "M. Mabete".

Wits School of Education

011 717-3416

cc Supervisor - Dr Nokulunga Ndlovu and Dr Paul Goldschagg



GAUTENG PROVINCE

Department: Education
REPUBLIC OF SOUTH AFRICA

8/4/4/1/2

GDE RESEARCH APPROVAL LETTER

Date:	12 June 2017
Validity of Research Approval:	06 February 2017 – 29 September 2017 2017/132
Name of Researcher:	De Almeida I.G
Address of Researcher:	P O Box 628
	Mondeor
	2091
Telephone Number:	072 594 3177
Email address:	inesdealmeida25@gmail.com
Research Topic:	Investigating the usefulness of Open Sankoré as a mapwork teaching tool for Grade 8 and 9 learners
Number and type of schools:	One Secondary School
District/s/HO	Ekurhuleni South

Re: Approval in Respect of Request to Conduct Research

This letter serves to indicate that approval is hereby granted to the above-mentioned researcher to proceed with research in respect of the study indicated above. The onus rests with the researcher to negotiate appropriate and relevant time schedules with the school/s and/or offices involved to conduct the research. A separate copy of this letter must be presented to both the School (both Principal and SGB) and the District/Head Office Senior Manager confirming that permission has been granted for the research to be conducted.

The following conditions apply to GDE research. The researcher may proceed with the above study subject to the conditions listed below being met. Approval may be withdrawn should any of the conditions listed below be flouted:

Faith Tshabalala 12/06/2017

1

Making education a societal priority

Office of the Director: Education Research and Knowledge Management

7th Floor, 17 Simmonds Street, Johannesburg, 2001

Tel: (011) 355 0488

Email: Faith.Tshabalala@gauteng.gov.za

Website: www.education.gpg.gov.za

1. The District/Head Office Senior Manager/s concerned must be presented with a copy of this letter that would indicate that the said researcher/s has/have been granted permission from the Gauteng Department of Education to conduct the research study.
2. The District/Head Office Senior Manager/s must be approached separately, and in writing, for permission to involve District/Head Office Officials in the project.
3. A copy of this letter must be forwarded to the school principal and the chairperson of the School Governing Body (SGB) that would indicate that the researcher/s have been granted permission from the Gauteng Department of Education to conduct the research study.
4. A letter / document that outlines the purpose of the research and the anticipated outcomes of such research must be made available to the principals, SGBs and District/Head Office Senior Managers of the schools and districts/offices concerned, respectively.
5. The Researcher will make every effort obtain the goodwill and co-operation of all the GDE officials, principals, and chairpersons of the SGBs, teachers and learners involved. Persons who offer their co-operation will not receive additional remuneration from the Department while those that opt not to participate will not be penalised in any way.
6. Research may only be conducted after school hours so that the normal school programme is not interrupted. The Principal (if at a school) and/or Director (if at a district/head office) must be consulted about an appropriate time when the researcher/s may carry out their research at the sites that they manage.
7. Research may only commence from the second week of February and must be concluded before the beginning of the last quarter of the academic year. If incomplete, an amended Research Approval letter may be requested to conduct research in the following year.
8. Items 6 and 7 will not apply to any research effort being undertaken on behalf of the GDE. Such research will have been commissioned and be paid for by the Gauteng Department of Education.
9. It is the researcher's responsibility to obtain written parental consent of all learners that are expected to participate in the study.
10. The researcher is responsible for supplying and utilising his/her own research resources, such as stationery, photocopies, transport, faxes and telephones and should not depend on the goodwill of the institutions and/or the offices visited for supplying such resources.
11. The names of the GDE officials, schools, principals, parents, teachers and learners that participate in the study may not appear in the research report without the written consent of each of these individuals and/or organisations.
12. On completion of the study the researcher/s must supply the Director: Knowledge Management & Research with one Hard Cover bound and an electronic copy of the research.
13. The researcher may be expected to provide short presentations on the purpose, findings and recommendations of his/her research to both GDE officials and the schools concerned.
14. Should the researcher have been involved with research at a school and/or a district/head office level, the Director concerned must also be supplied with a brief summary of the purpose, findings and recommendations of the research study.

The Gauteng Department of Education wishes you well in this important undertaking and looks forward to examining the findings of your research study.

Kind regards



Ms Faith Tshabalala
CES: Education Research and Knowledge Management

DATE: 12/06/2017

Office of the Director: Education Research and Knowledge Management

7th Floor, 17 Simmonds Street, Johannesburg, 2001

Tel: (011) 355 0488

Email: Faith.Tshabalala@gauteng.gov.za

Website: www.education.gpg.gov.za

Appendix F

Information sheets and consent forms to the principle, learners, parents and teachers.

LETTER TO THE PRINCIPAL

DATE: 13 June 2017

Dear:

The Principal of Bracken High School



My name is Ines De Almeida, I am a master's student at the School of Education at the University of the Witwatersrand. I am doing research on *The Pedagogical Value of Open Sankoré in Teaching Mapwork Skills to Grade 8 and 9 Learners in a South African Public School*. My research involves an investigation of the use of smartboard software to teach mapwork skills in Grade 8 and 9. The smartboard software that I will be investigating is called Open Sankoré. To investigate the usefulness of the smartboard software it is necessary that I observe four teachers teaching with the software to one Grade 8 and one Grade 9 class of their choice. I found that a lot of learners in Grades 8 and 9 battle with the section of mapwork and I want to investigate whether the digital tool is useful for teaching mapwork skills. Before the study commences a one-on-one training session will be set up with each teacher, to show teachers how to use the software. This training session will be scheduled for an hour after school. All teachers must attend training sessions for teachers not to be disadvantaged during the research. The training session is put into place to support and comfort teachers that will be participating in the study. Two interviews will be conducted with each teacher, for me to investigate the full potential of the smart board software. The two interviews will vary between 30-45 minutes each and will take up some of the teacher's time. I must emphasise however, that the research will not interfere with the academic programme at the school.

The reason why I have chosen your school is because of its openness towards integrating technological devices to improve teaching and learning. Your school was also chosen because of the accessibility of laptops, projectors and smartboards in the Social Science department. I am inviting the Social Science teachers and their learners to participate in this research to improve the teaching and learning of mapwork skills. The participants in the research will be given consent forms that must be signed. In the case of the learners, consent forms must also

be signed by their parent or guardian.

I must make clear that if the school chooses to participate in the research the four teachers and learners will not be advantaged or disadvantaged in any way. They will be reassured that they can withdraw their permission at any time during this project without any penalty. There are no foreseeable risks in participating in this study. The participants will not be paid for this study.

The names of the research participants and identity of the school will be kept confidential always and in all academic writing about the study. Your individual privacy will be maintained in all published and written data resulting from the study.

All research data will be destroyed between 3-5 years after completion of the project.

Please let me know if you require any further information. I look forward to your response as soon as it is convenient.

Yours sincerely,

A handwritten signature in black ink, appearing to read 'Ines De Almeida', with a stylized, cursive script.

Ines De Almeida
0725943177

458945@students.wits.ac.za

INFORMATION SHEET LEARNER'S

DATE: 13 June 2017



Dear Learner

My name is Ms. De Almeida, I am a master's student at the School of Education at the University of the Witwatersrand. I am doing research on *The Pedagogical Value of Open Sankoré in Teaching Mapwork skills to Grade 8 and 9 Learners in a South African Public School*. My research involves an investigation of the use of smartboard software to teach mapwork skills in Grade 8 and 9. The smartboard software that I will be investigating is called Open Sankoré. I found that a lot of learners in your grade battle with the section of mapwork. To understand if the smartboard software is a good tool to use to teach mapwork, it is necessary that I observe your Social Science teacher in the classroom. I will be audiotaping the lesson which your Social Science teacher is teaching you with the software and therefore indirectly, you will also be participating in the research. I will be observing your teacher for an hour which is one Social Science double.

I am wondering if you would mind if I observe your Social Science class while your Social Science teacher is teaching with the smartboard software. I need your assistance with the observation, by being attentive in class and asking questions when you do not understand what your teacher is saying during the lesson. Remember, this is not a test, it is not for marks and it is voluntary, which means that you do not have to do it. Also, if you decide halfway through that you would prefer to stop, this is completely your choice and will not affect you in a negative way.

I will not be using your name but and I will make up with one, to identify you. All information about you will be kept confidential in all my writing about the study. Also, all collected information will be stored safely and destroyed between 3-5 years after I have completed my project.

Please feel free to contact me if you have any questions. Thank you.

Your Sincerely,

A handwritten signature in black ink, appearing to be "De Almeida".

Miss De Almeida
458945@students.wits.ac.za

(011) 011 868 1056

LEARNER CONSENT FORM

Please fill in the reply slip below if you agree to participate in my study called: *The Pedagogical Value of Open Sankoré in Teaching Mapwork skills to Grade 8 and 9 Learners in a South African Public School*

My name is: _____

Permission to observe you in class

Circle one

I agree to be observed in class.

YES/NO

Permission to be audiotaped

I agree to be audiotaped during the observation lesson

YES/NO

I know that the audiotapes will be used for this project only

YES/NO

Informed Consent

I understand that:

- My name and information will be kept confidential and safe and that my name and the name of my school will not be revealed.
- I do not have to answer every question and can withdraw from the study at any time.
- I can ask not to be audiotaped, photographed and/or videotape.
- All the data collected during this study will be destroyed within 3-5 years after completion of the project.

Sign_____

Date_____

INFORMATION SHEET PARENTS

DATE: 13 June 2017



Dear Parent

My name is Miss I. De Almeida and I am doing research on *The Pedagogical Value of Open Sankoré in Teaching Mapwork skills to Grade 8 and 9 Learners in a South African Public School*. My research involves an investigation of the use of smartboard software to teach mapwork skills in Grade 8 and 9. The smartboard software that I will be investigating is called Open Sankoré. To investigate the usefulness of the smartboard software it is necessary that I observe four teachers teaching with the software. I found that a lot of learners in Grade 8 and 9 battle with the section of mapwork and I want to investigate whether the digital tool is useful for teaching mapwork skills. To understand if the smartboard software is a useful tool to use, it is necessary that I observe your child's Social Science teacher teaching your child with this software. I will be audiotaping the lessons which your child's Social Science teacher is teaching with the software, and therefore indirectly, your child will also be participating in the research. I will be observing your child's Social Science teacher teaching with the software for an hour, which is one Social Science double.

The reason why I have chosen your child's Social Science class is that all teachers in the Social Science department will be observed to have accurate data of the usefulness of the software. Would you mind if I observe your child's Social Science class while the teacher is teaching your child with the smartboard software. Your child has been asked to assist with the observation by being attentive in class and asking questions when they do not understand what the teacher is saying during the lesson. Your child will not be advantaged or disadvantaged in any way. She/he will be reassured that she/he can withdraw her/his permission at any time during this project without any penalty. There are no foreseeable risks in participating and your child will not be paid for this study.

Your child's name and identity will be kept confidential always and in all academic writing about the study. His/her individual privacy will be maintained in all published and written data resulting from the study.

All research data will be destroyed between 3-5 years after completion of the project.

Please let me know if you require any further information.

Thank you very much for your help.

Yours sincerely,

A handwritten signature in black ink, appearing to be 'I. De Almeida'.

Miss De Almeida
458945@students.wits.ac.za
(011) 011 868 1056

PARENT'S CONTENT FORM

Please fill in and return the reply slip below indicating your willingness to allow your child to participate in the research project called: *The Pedagogical Value of Open Sankoré in Teaching Mapwork skills to Grade 8 and 9 Learners in a South African Public School*

I, _____ the parent of _____

Permission to observe my child in class

Circle one

I agree that my child may be observed in class.

YES/NO

Permission to be audiotaped

I agree that my child may be audiotaped during observations.

YES/NO

I know that the audiotapes will be used for this project only

YES/NO

Informed Consent

I understand that:

- My child's name and information will be kept confidential and safe and that my name and the name of my school will not be revealed.
- He/she does not have to answer every question and can withdraw from the study at any time.
- He/she can ask not to be audiotaped, photographed and/or videotape
- All the data collected during this study will be destroyed within 3-5 years after completion of my project.

Sign_____

Date_____

INFORMATION SHEET TEACHERS

DATE: 13 June 2017



Dear: Teacher

My name is Miss I. De Almeida and I am doing research on: *The Pedagogical value of Open Sankoré in Teaching Mapwork Skills to Grade 8 and 9 Learners in a South African Public School*. My research involves an investigation of the use of smartboard software to teach mapwork skills in Grade 8 and 9. The smartboard software that I will be investigating is called Open Sankoré. I found that a lot of learners in Grade 8 and 9 battle with the section of mapwork and I want to investigate whether this tool can enhance the teaching of mapwork skills. To understand if the smartboard software is a useful tool to use, it is necessary that I observe you teaching with this software for an hour which is one Social Science double. I will be observing and audiotaping the lessons which you will be teaching with the software.

The reason why I have chosen your school is because of its organization in the Geography department as well as the availability of smartboards at the school. The school was also chosen because of its openness to integrate technological devices to improve teaching and learning. I am inviting you to participate in this research to understand the usefulness of Open Sankoré as a mapwork teaching tool.

Before the study commences there will be a one-hour training session in which I will teach you the basic skills of using Open Sankoré. I was wondering if you would mind if I observe you teaching with the software which will be audiotaped, as well as participating in two interviews which will be between 30-45 minutes each. The two interviews will also be audiotaped. Your name and identity will be kept confidential always and in all academic writing about the study. Your individual privacy will be maintained in all published and written data resulting from the study.

All research data will be destroyed between 3-5 years after completion of the project.

You will not be advantaged or disadvantaged in any way. Your participation is voluntary, so you can withdraw your permission at any time during this project without any penalty. There are no foreseeable risks in participating and you will not be paid for this study.

Please let me know if you require any further information.

Thank you very much for your help.

Yours sincerely,

A handwritten signature in black ink, appearing to read "Ines De Almeida".

Ines De Almeida
0725943177
458945@students.wits.ac.za

TEACHER'S CONSENT FORM

Please fill in and return the reply slip below indicating your willingness to be a participant in my voluntary research project called: *The Pedagogical Value of Open Sankoré in Teaching Mapwork Skills to Grade 8 and 9 Learners in a South African Public School.*

I, _____ give my consent for the following:

Permission to observe you in class

Choose one

I agree to be observed in class.

YES/NO

Permission to be audiotaped

I agree to be audiotaped during the interview and observation lesson

YES/NO

I know that the audiotapes will be used for this project only

YES/NO

Permission to be interviewed

I would like to be interviewed for this study.

YES/NO

I know that I can stop the interview at any time and don't have to answer all the questions asked.

YES/NO

Informed Consent

I understand that:

- My name and information will be kept confidential and safe and that my name and the name of my school will not be revealed.
- I do not have to answer every question and can withdraw from the study at any time.
- I can ask not to be audiotaped, photographed and/or videotape
- All the data collected during this study will be destroyed within 3-5 years after completion of my project.

Sign _____

Date _____

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