



Experiences of the Geography Subject Advisors in the Implementation of Geographic Information Systems in KwaZulu-Natal Province

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Article Info

Received: October 6, 2022

Accepted: January 9, 2023

Published: April 25, 2023

 10.46303/ressat.2023.5

How to cite

Mkhize, T. F. (2023). Experiences of the geography subject advisors in the implementation of Geographic Information Systems in KwaZulu-Natal province. *Research in Social Sciences and Technology*, 8(1), 63-73
<https://doi.org/10.46303/ressat.2023.5>

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ABSTRACT

This paper explored the experiences of geography subject advisors (GSAs) in the implementation of Geographic Information Systems (GIS) in South African schools. This was done to determine how they assist in the implementation of GIS. National senior certificate diagnostic reports for matric results indicate every year that learners are performing poorly in the GIS section of geography subject. The current literature shows that there is a lack of pedagogical content knowledge in geography teachers in the teaching and learning of GIS. Several scholars have written about learners and educators in the implementation of GIS in schools, but there is a lack of literature on GSAs' experiences in the implementation of GIS in schools. This paper is underpinned by instructional leadership theory, which argues for leadership to focus their efforts on implementing of practices that positively impact students' learning. Qualitative research approach, and semi-structured interviews were used to generate data to answer the research questions. Two GSAs from two selected districts were purposively chosen to participate in this study. The findings showed that GSAs organise workshops for educators. However, certain educators do not attend workshops and other workshops which are planned, do not materialise. GSAs rely on geography educators that are knowledgeable about GIS to assist in workshops by teaching others. GIS teaching in schools was alleged to be focused on a theoretical aspect without integrating the practical part. The study proposes that the DBE in collaboration with higher education institutions, should provide GIS teacher training opportunities for teachers.

KEYWORDS

Department of Basic Education; geographic information system, geography subject advisors, geography, instructional leadership theory

INTRODUCTION

The potential of Geographic Information Systems (GIS) on geography instruction has led to a global movement to include it in school curricula (Fleischmann & van der Westhuizen, 2020). Educational GIS was initially available only in the USA, Canada, and England, followed by Denmark, Germany, France, Finland, Sweden, the Netherlands, and other developed countries (Fleischmann & Westhuizen, 2017). In the 1990s, educational GIS in secondary schools was extended to developing countries in Asia such as China, Malaysia, and India, and in Africa, it was extended to Nigeria, Uganda, Rwanda, and South Africa (Akinyemi, 2015; Kerski et al., 2013). However, despite the increased focus on educational GIS, many teachers worldwide still struggle to find appropriate means of presenting GIS practical lessons or applying GIS in their classrooms. In South Africa, GIS was listed as a skill to be acquired in the National Curriculum Statement (NCS) in 2003, although its actual inclusion in the curriculum was only phased-in from 2006. In 2006, the Department of Basic Education (DBE) introduced GIS as part of the grade 10 geography syllabus for the first time and it extended this to include grades 11 and 12 in 2007 and 2008, respectively (Fleischmann & van der Westhuizen, 2020).

Several studies have been conducted on teaching of GIS in the Southern African secondary schools. Fleischmann and van der Westhuizen (2019) review the current state of GIS application in southern African secondary schools. They argue that there is no GIS education in secondary school curricula, shortage of experienced teachers, lack of knowledge and technical expertise, unwillingness of teachers to change their teaching mode, a shortage of funds, and inadequate resources. Fleischmann and van der Westhuizen (2019) concluded that there should be an infusion of interest and collaboration across borders to exchange knowledge and support.

Similarly, Mkhongi and Musakwa (2020) note that there is progress in the teaching of GIS in secondary schools. However, the full potential of GIS education has been restricted by challenges such as inadequate resources and limited exposure of students to GIS's practicals. This is consistent with a recommendation that GIS education in South African schools should be accompanied by appropriate hardware, software, and opportunities for exposing students and educators to practical methods of teaching and learning GIS (Mkhongi & Musakwa, 2020). Tarisayi and Zondi (2020) in their paper that explored a learner's perspective on the implementation of GIS in selected schools in the KwaZulu-Natal province argue that the learners lacked fundamental knowledge of GIS and that GIS was not being properly taught. However, the study did not recommend solutions to the problem to assist learners in obtaining fundamental knowledge of GIS.

While the above studies have contributed to the study of GIS in schools, none of the studies has focused on the experiences of geography subject advisors in implementing GIS in schools. Therefore, my study is unique in that it argues for geography subject advisors to play their role in implementing GIS in schools. In light of this, the aim of the study is to explore geography subject advisors' experiences in the implementation of GIS in schools, determine how they assist in the implementation of GIS and suggest how DBE, in collaboration with

institutions of higher education, should provide GIS teacher training opportunities for teachers to advance their knowledge of GIS. The paper is arranged as follows: theoretical framework, methodology, findings, and conclusion and recommendations.

Research questions

- What are the experiences of geography subject advisors in the implementation of GIS in schools?
- How do geography subject advisors assist in the implementation of GIS in schools?

THEORETICAL FRAMEWORK

This paper is framed under weber's (1996) instructional leadership theory. The early developments of the theory were made by Hallinger and Murphy (1985) in their model of instructional management by examining the instructional leadership behaviour of 10 elementary school principals and reviewing the literature on school effectiveness. According to Hallinger and Murphy (1985), instructional leadership is a strong and directive leadership that focuses directly on curriculum and instructional practices. However, with the evolution of transformational leadership in 1990, Cuban (1988) and Lambert (1998) highlighted the limitation of the Hallinger and Murphy (1985) model as they believed that instructional leadership only focuses on the principal as the centre of expertise, power, and authority by deliberately ignoring the other facets which ultimately put the burden for any one person.

Weber's (1996) instructional leadership theory developed on Hallinger and Murphy's theory and added more pillars to the understanding of instructional leadership. The model comprises six interrelated functions. These include setting academic goals, organising the instructional leadership, hiring, supervising, and evaluating teachers, protecting instructional time and programmes, creating a climate for learning, and monitoring achievement and evaluating programmes. To address the findings of the study, the following pillars of the theory framed the study: setting school academic goals, organising the instructional leadership, creating a climate for learning, and monitoring achievement and evaluating programmes.

For setting school academic goals: the instructional leader should always give guidance and direction based on the organisation's objectives and philosophy (Adams et al., 2018; Weber, 1996). Weber (1996) makes a convincing assertion that for any school or education district to have effective leadership, quality teaching and learning and improved learner attainment, there must be well-formulated vision, goals and mission that provide an impetus and direction to all leadership, governance, and curriculum matters. The geography subject advisors as leaders should set, communicate, and work with educators towards achieving those academic goals in the effective implementation of GIS in schools. For organising instructional leadership: the principal has a duty to perform instructional organisation and coordination which comprises subject groupings, student groupings, teacher organisation, leadership teams and the structure of the curriculum (Mooi, 2018; Weber, 1996). I argue that it is the responsibility of the

geography subject advisor to perform instructional organisation, coordinate, and run programmes such as workshops aimed at effective teaching and learning of GIS in schools.

For creating a climate for learning: the school climate serves as a motivating factor for both educators and learners in their academic and professional work (Alnasser, 2019; Weber, 1996). The learning climate is associated with norms, values and attitudes prevailing in a school, which characterise the behaviours of educators and learners (Ma'mun, & Suryana, 2019; Weber, 1996). He further suggests that teacher expectations determine the amount of time dedicated to teaching and learning and the quality of materials and activities. Consequently, subject advisors need to improve the learning climate through high expectations.

For monitoring achievement and evaluating programmes: monitoring and evaluating the school programme is key to successful instructional leadership. It is an integral part of the teaching and learning process (Islam et al., 2019; Weber, 1996). The subject advisor has a primary duty to evaluate and revise the instructional programme in an institution (Amin, & Yasin, 2018; Weber, 1996). Therefore, this theory is relevant to this study because the geography subject advisor is an instructional leader, in terms of all the pillars of instructional leadership discussed; all of them should be fulfilled by the geography subject advisors for effective teaching and learning of GIS to take place in schools. I chose this model because it relates well with the topic of the study as the subject advisor is an instructional leader.

METHODOLOGY

This paper is located within the interpretive paradigm to understand the participants' experiences. The main assumption of this paradigm is that reality is socially constructed and that there are as many intangible realities that people construct (Hathcoat et al., 2019; Kivunja & Kuyini, 2017). As an interpretive researcher, I explored geography subject advisors' experiences in the implementation of GIS in schools; and determined how they assist in the implementation of GIS. In this way, different interpretations from geography subject advisors were obtained because their realities were not the same. Thus, I was able to engage in geography subject advisors' experiences subjectively to understand their journeys. This paper adopted the qualitative research design. Such an approach is deemed appropriate because qualitative findings are always based on human experiences and stories which cannot be measured, counted, or controlled (Allan 2020; Silverman, 2020). The qualitative research design was suitable for this paper because it hoped to understand the geography subject advisors' experiences in the implementation of GIS in schools.

This paper adopted a case study research design because the case study systematically captured the reality of the geography subject advisors' lived experiences of supporting geography teachers in implementing GIS in schools. These were resource-poor schools in rural communities. The quintile categorisation of the schools is the same and they qualified as no-fee schools (Hall & Giese, 2009). These schools are under quintile two and learners do not pay fees because the schools are located in poor communities. The quintile of a school is based on the

relative wealth of the surrounding communities (Kern et al., 2018). The participants were two geography subject advisors in two districts in KwaZulu-Natal Province, South Africa. This paper adopted non-probability sampling in which the chance or probability of each unit being selected is not known or confirmed (Rahi, 2017). This means that participants in the non-probability sample are not given an equal chance to participate; instead, they are selected on the basis of their accessibility or by the purpose and personal judgement of the researcher. Therefore, by utilising non-probability sampling, I was enabled to be purposive and make personal judgments in selecting the participants.

This paper adopted semi-structured interviews as the data generation tool. The open-ended questions enabled me to ask follow-up questions such as why or how questions. Magaldi and Berler (2020) state that the researcher in the semi-structured interview can explore new paths that emerge during the interview that may not have been initially considered. The semi-structured interviews enabled me to word questions instinctively and developed a conversational style during the interview that focus on the topic. The paper adopted the thematic data analysis. Data analysis is the process of systematically interpreting data using analytical and logical techniques to determine useful information (Braun & Clark, 2016). The thematic data analysis enabled me to see and make sense of the collective or shared meanings and experiences indicated by the data set. The semi-structured interviews data were analysed utilising a combination of deductive and inductive thematic analysis approaches.

Department of Basic Education granted permission to engage geography teachers in the selected districts within the Province of KwaZulu-Natal. Permission from the districts managers' gatekeepers was also obtained. I also approached the ethics committee of the University of KwaZulu-Natal (UKZN) to apply for ethical clearance to conduct this research to avoid any potential harm against the participants. All participants participated voluntarily and held a right to withdraw at any time (Hasan et al., 2021). The consent letter that was provided to the participants also included the following: willingness to participate and consent for the use of audio and video equipment during the engagements. To avoid any kind of identification of individuals, the confidentiality of the participants was guaranteed by using pseudonyms for the districts and participants. According to Arifin (2018), this is called nonmaleficence, where harm is avoided to those involved in the research. I motivated participants to share their views about their role in the implementation of GIS in schools but did not specify participants' names or districts' names in the data presentation to ensure adequate anonymity.

Findings and discussions

This section presents the discussion of findings that emerged in the study. The findings of this study are presented in this section as verbatim narrations in correlation with literature and the theoretical framework. The data generation tool used was semi-structured interviews with two geography subject advisors namely: GSA 1 and GSA 2. The aim was to explore the experiences of geography subject advisors implementing GIS in the South African schools; and determine how they assist in the implementation of GIS. The findings are presented as themes, that the

researcher generated using a combination of deductive and inductive approaches. Both participants responded to the two research questions of the study.

Geographic Information system workshops

The study established that geography subject advisors (GSAs) organise content workshops for geography teachers to discuss GIS teaching and learning in schools. However, it was apparent that as GSAs engaged geography teachers in these workshops, they experienced several challenges. GSA 1 comments that:

“There are workshops that I have organised for training teachers on GIS. There was one that was done last year virtually, which was supposed to be attended by all teachers in the province, but you find that the issue of network, the issue of cellphone data hindered...teachers from attending that workshop which was virtual last year.” (GSA 1, Female, ten years’ experience in advisory services)

In a similar way, GSA 2 explained:

“We planned training workshops which have not yet materialised because of the challenge of not finding time at the moment to conduct workshops on GIS. However, we provided past-year question papers to teachers from the province.” (GSA 2, Female, one year experience in advisory services)

From the above excerpts, there is evidence that GSAs assist teachers in implementing GIS through geography content workshops. This is consistent with the findings by Fleischmann and Westhuizen (2020), who point out that the GIS training programmes organised by DBE help teachers learn how to help schools to implement GIS. Weber’s (1996) pillar of organising instructional leadership corroborate this finding by pointing out that the principal must perform instructional organisation and coordination, which comprises subject groupings, student groupings, teacher organisation, leadership teams and the structure of the curriculum. This means that it is the responsibility of the geography subject advisors as instructional leaders to ensure that they take responsibility for organising GIS workshops in which teachers are taught.

Use of GIS knowledgeable educators in workshops

The use of knowledgeable geography teachers that are within that district to assist other geography teachers in the implementation of GIS was evident. This was because GSA found GIS difficult because they were also not taught GIS at school or the tertiary level. GSA 1 elucidate:

“Since the department of education does not have money, we sometimes use geography teachers who understand GIS better especially novice teachers because they were taught GIS at the university. Some of them got it in secondary schools and universities. So, we use those geography teachers so that they can be able to teach all the other teachers that were not exposed to GIS during their time.”

GSA 2 adds the reason for her to find GIS difficult and frustrating to teach to equip geography teachers on how to teach it to learners. GSA 2 explains articulates:

“Application of map work and GIS is a challenging section. It is challenging to teach learners or teachers while I was also not exposed to the topics. It is ok to include GIS, yet frustrating...”

Hence, it can be noted from the above-mentioned comments by the participants of the study that they are aware that one of their roles as instructional leaders is to teach educators about how GIS must be implemented in schools. However, GSA discovered that they are also unfamiliar with GIS, and therefore strategies on utilising some geography educators to teach other geography educators about GIS implementation in schools during workshop sessions. The literature is inline with the above-mentioned position by participants. The literature reveals that despite South Africa being ahead of other African countries, South Africa also experiences a shortage of experienced GIS personnel. Shortage of technical support and training; lack of in-service training; complicated software and a lack of proper teacher guidelines; poor funding, and inadequate infrastructure in secondary schools have also been mentioned as challenges (Breetzke et al., 2011; Fleischmann & Westhuizen, 2017; Musakwa, 2017; Rust, 2008). Since it is the knowledgeable educators that end up teaching GIS to other educators in these workshops. It might be that those who teach others end up not benefiting or growing since they do not learn anything new.

GIS implementation from a theoretical perspective

The findings of the study also indicated that GSAs assistance in GIS implementation in South African schools is practiced from a theoretical perspective and not done using the actual GIS programme to engage learners with GIS tools. GSA 1 explains:

“I assist teachers to implement the teaching and learning of GIS in schools from a theoretical perspective and not practical perspective. GIS taught in our schools is the one that teaches only the concepts of GIS. So, it becomes a problem for learners when teachers go deeper with GIS, because they cannot see the practical part of GIS. For example, how maps are made, how data is layered, and so on. So those are the things that are difficult when it comes to GIS. So, resources for its implementation at a practical level are not available.”

In line with GSA 1, GSA 2 also indicated the lack of resources in the implementation of GIS in school that makes it abstract and difficult for learners to understand easily because educators tend to for solely on theory and not on practice. GSA 2 articulates:

“The challenge is that we don’t have the necessary resources that we can make our teachers use to make it easy for learners to understand geography.”

Considering the above responses, the GSAs view GIS as a topic that is supposed to be taught practically to learners. The belief is that if GIS is taught with the integration of the practical aspect, it might become easier for the GSAs to explain to educators the ways they can use to make it easier for them when they must use to make learners understand GIS in the classroom. Similarly, Fleischmann & Westhuizen (2017) reveal that teachers worldwide still struggle to find appropriate ways to present GIS practical lessons or apply GIS in their classrooms. The primary reasons for this, as stated by Aladag (2014) and Bednarz (2004) and many other scholars, are as follows: The need for software, hardware and usable data, as well

as other technical obstacles; The unwillingness of teachers to spend time and effort learning new technologies unless there is institutional support or advantage to their career; Teachers' insufficient knowledge of how to teach using GIS coupled with the lack of curriculum-based material; and The lack of experience using spatial information.

CONCLUSION AND RECOMMENDATIONS

This study concludes that geography subject advisors are aware that their role in implementing GIS is to assist teachers through organising workshops that will capacitate educators with the teaching and learning of GIS in schools. However, the challenge to workshops is that certain educators do not attend workshops organised because of a number of hinderances they face. Another issue that emerged from the findings is that a geography subject at times organise a workshop and end up not materialising. The workshop that ends up not taking place compromises the effective teaching and learning of GIS in schools as some geography educators are struggling with understanding the topic themselves, yet they are expected to teach it to learners. According to the NSC diagnostic report for matriculants, this might explain why learners are performing poorly in the GIS section in mapwork every year.

The findings also suggest a lack of GIS content knowledge amongst certain geography subject advisors. The lack of GIS content knowledge is caused by the fact that they were not taught GIS at school and at the tertiary level. The lack of knowledge in the implementation of GIS contributes to geography subject advisors not being able to fulfil their role as instructional leaders to facilitate programmes in which they engage educator themselves in the teaching and learning of GIS in schools. Another issue is that of teaching GIS from a theoretical perspective without the integration of the practical perspective. The findings imply that GIS teaching and learning will always be difficult as long as it is taught from a theoretical perspective. This is because teaching from a theoretical perspective without incorporating practice not only makes GIS difficult for teachers to teach but also makes it abstract and difficult for learners to understand.

The study recommends that the Department of Basic Education (DBE), in association with universities, should provide formal training to both geography subject advisors and teachers and provide them with the necessary resources across all schools to ensure the effective teaching of GIS in a geography classroom. The provision of resources may assist in addressing the teaching and learning of GIS integrating the practical aspect for learners to understand GIS better. The training may be rendered in the form of prolonged workshops that focus on GIS implementation in schools. The DBE may also allocate funds in schools for resources required for GIS implementation. The DBE workshops aiming at supporting teachers with GIS implementation should include strategies that would enable geography teachers to simplify the complexity of GIS concepts taught to learners in schools.

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