Improving the quality of Geography Teacher Education through Geographical Information Systems and Self-Directed Learning

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Abstract

Quality of education in the training of geography teachers by institutions of higher education is a significant concern. This study focused on the enhancement of the quality of pre-set geography education through the inclusion of geographical information systems (GIS), and self-directed learning (SDL)—as supported by Dewey's theory of education. This study undertakes a systematic review of the relevant literature, focusing on peer-reviewed publications. It examines the

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connection between teaching through GIS and the enhancement of SDL skills in pre-set geography teacher-training curricula at universities. A careful look at existing studies indicates a link between GIS, SDL and the enhancement of the quality of the education received by geography teachers in training. This study thus recommends that GIS and SDL skills be included in teacher education to make it possible for student geography teachers to become productive in society.

Keywords: Dewey's theory; geography teacher; higher education; quality education; Self-Directed Learning (SDL); Geographical Information Systems (GIS)

Introduction

Ensuring the quality of education in institutions of higher learning is of significant concern to students, academics, researchers, employers and society as a whole (Dicker et al., 2019; Nadiri et al., 2009). However, "quality education" is one of those terms in the higher education arena that is unclear, multidimensional and difficult to define (Roopa et al., Senthil, 2021; Dicker et al., 2019; Nadiri et al., 2009). This article concentrates on definitions of quality education that highlight the link between institutional education and preparation for life during and on completion of this education. Within this approach, quality education helps to prepare students not only for assessment but also for life after tertiary education by focusing on the student as a whole – socially, emotionally, mentally,

physically and cognitively (Whalley, 2019; Zhong, 2019). Furthermore, quality education helps determine how well students learn and how their education turns into personal, social and developmental benefits (Latif et al., 2019). In addition, quality education helps enlighten students pedagogically and developmentally, encouraging them to become active and productive members of society (Dicker et al., 2019; Latif et al., 2019).

Quality education is perceived variously by different stakeholders as suits their particular context (Dicker et al., 2019; Schindler et al., 2015; Santos et al., 2020). For instance, a study at Kingston University in the United Kingdom (Dicker et al., 2019) found that educators and students defined quality education in terms of the teaching and learning process. Defined in this way, quality education can be described as the use of better

methods of teaching and learning to help transform students' perceptions and how they apply their knowledge to real-world problems (Dicker et al., 2019). Universities also have a significant role in assisting students in developing and establishing personal skills through different ways of teaching and learning (Dicker et al., 2019; Kablan & Kaya, 2014). On the other hand, employers define quality education in terms of graduates' performance in the work environment (Dicker et al., 2019; Frache et al., 2019; Santos et al., 2020). In other instances, quality education may refer to quality educational services offered by or acquired within the system of higher education. For example, depending on the type and location of a university, educators, students and society may have their own expectations of the professional services (signifying quality education) to be rendered by that particular institution (Dicker et al., 2019; Popkewitz, 2018). In Santos et al. (2020), universities need to foster a more holistic reflection of themselves as academic institutions that influence social environments. This approach is embodied in practices related to the development of land-grant universities in the United States of America (USA), where people in communities linked to the land-grant

institutions (there is one in each state) are entitled to present problems for a solution to experts in a particular field at the university concerned. The knowledge model used in solution-seeking of this kind features research patterns motivated by the rapid development of new knowledge and the fast progression of access to data throughout societies and economies (Winchester, 2005).

How teaching and learning materials or tools are organised and delivered to students is also a matter of quality (Billi, 2018; Alenezi, 2020). Active engagement and a high level of learning occur, in the main, when students are fully involved in a teaching and learning process that covers the use of challenging tools (Kablan & Kaya, 2014). GIS are one of the teaching and learning tools in geography that inspire active involvement by students and help to develop their SDL skills (Fleischmann & van der Westhuizen, 2017; Hall-Beyer, 2019; Huynh & Hall, 2019; Mzuza & van der Westhuizen, 2019).

Most geographical phenomena have a spatial dimension and operate in a continually changing environment. Geospatial thinking is a significant component of geography, manifested in cartography, map work and aerial photographic skills and calculations,

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and in the analytical capability of GIS for thematic map generation (referred to as the practical component of geography education).

South African universities offer two modes of delivery for the further education and training (FET) phase (grades 10 to 12) of geography teachers-a four-year B.Ed. and a one-year Postgraduate Certificate of Education (with geography as a three-year major in the first degree). Four-year FET college diplomas with similar content can also be obtained.

The training of geography teachers for the further education and training (FET) phase (Grades 10 to 12) is usually carried out at universities in South Africa, and these institutions offer two modes of delivery: a four-year B.Ed.; and a one-year Postgraduate Certificate of Education (with geography as a three-year major in the first degree). Four-year FET college diplomas with similar content can also be obtained.

During teacher training, the focus is not only on acquiring content knowledge but is also on the methodology or the didactics of teaching this content to learners in the different phases, including the practical component for FET-phase geography, in which GIS are central.

Problem statement

Worldwide, studies have been carried out on quality education in higher education. These include, for instance, studies in the United Kingdom (Dicker et al., 2019); Pakistan (Latif et al., 2019); China (Zhong, 2019); Australia (Graham et al., 2020), and South Africa (Motala, 2001). Other countries covered in these studies are Argentina, Canada, various European countries, Hong Kong and India, and countries in Southern Africa (King et al., 2011). Despite the numerous studies that have been conducted, none has focused on enhancing quality education through the inclusion of GIS and SDL skills regarding applicable theories of education. Yet it is essential to cover technological methods such as GIS applications when teaching prospective geography teachers to motivate them by stressing the practical aspects of their studies. All geography teachers need to understand the extensive use of computers and other digital tools in their subjects.

Therefore, this review article aims to examine the connections between teaching through GIS and the enhancement of SDL skills in geography teachers' training, to discuss how the inclusion of GIS and SDL skills

in geography teachers' education at universities helps enhance the quality of their education, and to discuss the importance of quality education to students, employers, and society. Therefore, recognising the importance of GIS and SDL skills in geography teachers' education is necessary to understand their contribution to the enhancement of quality education in institutions of higher learning.
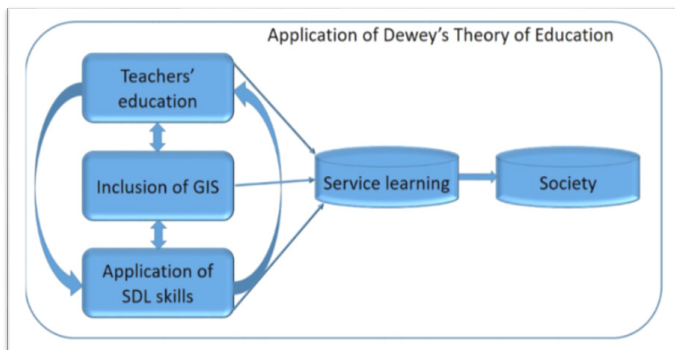
Conceptual or theoretical framework

Based on widespread acceptance of the critical tenets of Dewey's (1938) theory of education, schools have come to believe in the value of using different teaching and learning methods to meet the needs of all their students. Dewey proposed that each student is unique, with their own learning style, and that it is crucial to recognise that students learn differently from one another (Dewey, 1938; Williams, 2017). Most students in a class will grasp concepts well if various methods are used to teach them these concepts (Williams, 2017). Dewey also held that students learn better in their natural social setting. Practical teaching methods might help them participate in the learning and teaching processes by allowing them to demonstrate their way of solving problems), thereby boosting their motivation (Flinders & Thornton, 2013; Mentz et al., 2020).

The first concept reviewed in this article is the link between teaching through GIS and the enhancement of SDL skills in geography teachers' training (Figure 1), as demonstrated by Mentz et al. (2020).

Figure 1: Application of Dewey's Theory of Education and SDL skills in teachers' education (adapted from Dewey, 1938)

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SDL helps students control their learning process (Wijnia et al., 2019) by making them responsible for planning, implementing, and evaluating their learning outcomes (Knowles, 1975; Mentz et al., 2020). SDL can also be defined as the ongoing commitment of students to attain, apply and generate knowledge and skills to solve problems according to different situations (Nepal & Stewart, 2010; Mentz et al., 2020). SDL refers to numerous learning practices related to self-instigated, autonomous learning (Beckers et al., 2019). On the other hand, Egiebor and Foster (2019) define GIS as a tool that permits students to discover, scrutinise and interpret data from a spatial viewpoint, supporting students' involvement, learning, and performance in the classroom. GIS can also be defined as powerful tools for collecting, retrieving, transforming, and displaying spatial data from the real world (Healy & Walshe, 2020; González et al., 2020; Fleming & Evans, 2021).

As a teaching and learning tool, GIS can be used for different purposes in a variety of subjects, for example, in decision-making and environmental analysis (Mkhongi & Musakwa, 2020). Although GIS is a recognised teaching and learning tool, the connection between its use and any real-world situation must be adequately explained to students. In other words, it is crucial to show students the specific ways in which they can use GIS as a tool. Studies have shown that students' perceptions of the value and nature of GIS are not well understood (Healy & Walshe, 2020; Pike, 2020). Given this limited understanding, this article will discuss how GIS can be used to enhance the SDL skills of geography student teachers at university; and what the significance is of accommodating SDL skills in teacher training. In addition, the article explains how the inclusion of GIS and SDL skills enhances quality education at the university level in relation to Dewey's theory of inquiry and learning.

John Dewey was an American philosopher who proposed a progressive education system in which teachers presented real-life problems to be solved by students through hands-on activities (Putnam et al., 2009; Sung, 2019; Vescan, 2019). Dewey's theory was founded on a child-based approach, in which school students were allowed to explore their environment (Putnam et al., 2009; Vescan, 2019). According to Dewey, an inquiry arises when an organism comes across an indeterminate situation in the environment (Putnam et al., 2009; Sung, 2019; Vescan, 2019).

This increase in inquiry as an organism comes across an unfamiliar situation relates to Kolb's experiential learning theory. Different learning styles are described according to personal choice in the learning environment (Kablan & Kaya, 2014). Kolb (as cited in Kablan & Kaya, 2014) states that there should be a link between what students learn in class and their future work. In addition, Kolb believes lecturers should develop practical skills linked to real-life situations to prepare graduates for life's experiences (Kablan & Kaya, 2014).

Methodology and methods

A systematic review of the literature was undertaken to respond to the research questions, including a review of information concerning the concept of quality education in higher education. The review covered both information explaining the connection between the inclusion of GIS in the training of geography teachers and the enhancement of SDL skills in teachers' education and information spelling out how quality education can be enhanced through the inclusion of GIS and SDL skills. This information was collected from peer-reviewed empirical studies in GIS skills, geography, and teacher-training universities. Peer-reviewed publications from 2010 onward were screened to understand the concepts at play. However, only recent work has been referred to in this article. The key terms used when searching for the information included the following: "inclusion of GIS", "geography teacher training," and "SDL skills".

Salam et al. (2019) assert that a systematic review helps discover the outcomes of most studies conducted in a related field of study. This agrees with Harte (2017), who argues that a systematic review values the results of other studies, especially those of scholars who are experts in the same field of study. This study focused on geography experts in pre-service teacher training at universities that included GIS skills in their geography content. It also concentrated on teacher-training specialists in quality education, especially higher education. Although many articles were reviewed, this article reflects mainly citations from material that appeared in three recent years (2017–2020). Older sources have been used in situations where information from recent studies was not available.

Using the literature gathered based on these criteria, the article discusses the connections between the inclusion of GIS and SDL skills in the syllabus of teaching institutions and

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the enhancement of quality education in terms of students' outcomes and ability to fit into a modern industrial society.

Results and discussion

Relationship between GIS and the enhancement of SDL skills

The use of GIS helps student teachers develop spatial thinking skills in geography and related subjects (Bednarz & Lee, 2019; Hall-Beyer, 2019; Lee et al., 2018; Norton et al., 2019). For example, GIS maps enable students to develop a sense of place by enhancing their observation abilities (Dolan & Liston, 2020). In this article, spatial thinking can be defined as a combination of three aspects: the building of cognitive skills through spatial concepts; the use of emblematic tools; and process-linked reasoning (Ridha et al., 2020). Students become more active, participatory, and self-directed when they explore spatially (Lü et al., 2019), thereby enhancing their SDL skills (Nazareth et al., 2019; Peacock, 2018; Wise, 2018). Lü et al. (2019) report that basic GIS functions such as computer mapping and related tools help provide students with 2D, 3D, or even 4D visual and digital images of the physical world (time being the

fourth spatial dimension represented). According to Lü et al. (2019), by using GIS, students may have enjoyment, alter simulated geographic setups to learn about and contemplate the results of such alterations, and take part in virtual activities to find various possible solutions to problems at hand (Lee et al., 2018). Concerning this third aspect, Lü et al. (2019) argue that teaching and learning through GIS can be a powerful means of solving geographical problems. In some cases, for example, teachers may use maps in social science to help students answer questions relating to real-world problems (Milson, 2019). This agrees with Dewey's theory of education of learning by doing.

Lecturers need to include activities or pedagogies that influence student teachers to participate actively in the learning process (Mzuza & Van der Westhuizen, 2019; Jung, 2020). This means providing hands-on activities that allow students to find answers independently and develop SDL skills. GIS also helps students learn through hands-on activities in which computers and smartphones are frequently involved (Han, 2019; Collins & Mitchell, 2019; Fleming & Evans, 2021). Teaching through GIS entails mainly making maps, which helps students connect what

they learn in class with real-world situations, thereby enabling them to develop SDL skills that may help them after they have graduated and entered the work environment. This has made GIS more applicable and popular in modern daily life (Han, 2019; Holler, 2019; Fleming & Evans, 2021).

How the inclusion of GIS and SDL skills enhances quality education

Studies show that a better presentation of both content and pedagogics helps prepare future geography teachers (Mitchell, 2018), suggesting that neither content nor methodology can in isolation produce good geography teachers but that a combination of the two can. The improvement of content and better teaching methods by teachers of geography students are necessary to improve the quality of future geography teachers. Practices learned and skills gained in an environment such as this may help student teachers in the discipline of geography present content in more interesting, effective, and convincing ways to their students (Harte, 2017). This is in agreement with studies conducted on the inclusion of geospatial technology in the education of geography student teachers in America, England and the rest of the

United Kingdom, Israel, New Zealand, and South Africa (Golightly, 2019; Harte, 2017; Jo, 2016; Medzini et al., 2015; Mitchell, 2018; Mzuza & Van der Westhuizen, 2019; Walshe, 2017). These studies have demonstrated that using geospatial technology, such as GIS, when teaching geography helps students gain SDL and spatial thinking skills (Jo, 2016; Schweder, 2020). For example, students using spatial thinking and SDL skills improve their education in terms of their grades and the quality of their work after attaining their qualifications. SDL skills gained at school help teachers and students solve problems and develop appropriate solutions in their working environments (Chung & Lee, 2019). This agrees with the arguments of Dewey's theory, in which students are allowed to discover their environment; identify problems on their own, and formulate solutions concerning the situation at hand (Putnam et al., 2009; Vescan, 2019). The ability of students to solve problems on their own is also in line with Kolb's experiential learning theory, in which the skills learnt at school should apply to real-life situations (Kablan & Kaya, 2014). In this case, the inclusion of GIS, which involves hands-on activities and activated SDL skills in geography and other courses, may help improve the

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quality of education so that graduates can continue to be productive in their respective fields beyond their studies. This is required in the current technological world — adapting to and changing according to the environment to fit in that environment and overcome emerging problems within it.

The importance of quality education

Quality education is important to students, employers, and society (Dicker et al., 2019; Nadiri et al., 2009; Shurair & Pokharel, 2019). Graduates may be regarded as having acquired quality education in higher education by obtaining higher grades and meeting the community's demands (Dicker et al., 2019; Leu, 2005; Nadiri et al., 2009). They should be able to respond to questions or solve problems in their community or workplace. In the world as it is now, many things are changing rapidly, and self-directed learning skills that students gain at school and university may help them solve several problems in daily life. Employers and communities generally expect more from graduates than they did before, and students thus need to be more broadly and better prepared to meet the demands of the society of which they form part.

Institutions of higher learning also need to consider their communal image and the cultural value they offer, as these aspects can influence the types of services they provide (Dicker et al., 2019; Shurair & Pokharel, 2019). This approach may also help an institution to maintain its integrity. Irrespective of where the institution is located geographically, its students should be capable of understanding the cultural values of the surrounding community. In this context, "cultural values" means what people in that community believe to be important and require action. Institutional integrity is more likely to be achieved if graduates from a university or similar institution behave in ways that show they are in touch with the general community and its needs.

Moreover, because quality education is defined depending on the needs of distinct communities or industries, the environments in which students are trained must be considered. This agrees with the approach of Dewey, which advocates a progressive system of education in which educators teach with real-life situations so that students can fit into the work and life environments they will be entering later (Cattaneo et al., 2019; Putnam et al., 2009; Sung, 2019; Vescan, 2019). It is also in line

with the views—covered above—of Kolb and Kablan, and Kaya (2014). In other words, skills gained in school should be linked or applicable to real-life experiences (Ge & Chua, 2019). In modern society, students must gain skills that will be of technological assistance in helping them to fit into a rapidly changing world. SDL skills may therefore be helpful to students because they will make it easier for them to adapt to and fit into most of the situations they may encounter in their communities and workplaces and the world in general.

Conclusion

The findings of this review article show that there is a connection between teaching through GIS and the enhancement of SDL skills in geography teachers' education. By learning through GIS, students can think on their own, reach an answer to questions and problems, learn through trial and error, and be creative in devising solutions. We have demonstrated that including GIS and SDL skills in geography teachers' education at university enhances quality education. Quality education is defined variously, depending on the needs of students and lecturers, the community, or the industry. The industry defines quality education in its ability to offer better services and continued productivity in a changing technological world. SDL skills that might be gained or activated by learning through GIS may contribute to students obtaining a quality education. We have also shown, through examples, that quality education is important to students, employers, and society as a whole, as proposed by Dewey's theory of education and Kolb's experiential learning theory.

Moreover, we think that GIS should be introduced as a critical aspect of education, not only for student teachers of geography but also in all subjects with which GIS has a natural fit. Policymakers and educators should consider the inclusion, in the curriculum, of teaching methods that involve gaining GIS and SDL skills. More research should be conducted to understand how some learning theories can be applied to teaching through GIS. More research is also required to ensure ways of obtaining and delivering quality education in higher education to meet the ever-changing demands of society.

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