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ANALYSIS OF OPPORTUNITY-TO-LEARN GEOGRAPHIC INFORMATION SYSTEM FROM TWO GEOGRAPHY TEXTBOOKS IN SOUTH AFRICAN SECONDARY SCHOOLS

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Abstract
Although learners were found to be passing geography as a subject, not attempting to answer Geographic Information System (GIS) questions is a concern. Using the Opportunity-to-Learn (OTL) framework, this study analyzes the cognitive level of tasks on GIS presented in two geography textbooks used in South African Secondary schools. This qualitative research employs analytical content design to analyze data, utilizing Bloom's taxonomy. A non-probability sampling technique, convenience sampling, was used to select two Geography textbooks. One of the findings showed that there are fewer tasks in both textbooks that address the concept of GIS, and these tasks are mainly of a Lower cognitive level. The research is useful to the Department of Education in informing textbook choices and to the subject specialists. It concludes that there is a need for a more strategic approach in designing and selecting GIS tasks in geography textbooks. This study recommends that the education system in South Africa should adapt to the advancements of the Fourth Industrial Revolution, utilizing GIS technology.

Keywords: Bloom's taxonomy, Geographic Information System (GIS), Opportunity-to-Learn (OTL), Textbooks

Introduction
A Geographic Information System (GIS) is a concept in Geography that deals with using integrated computerised technology to understand geographical data. GIS is a system for storing, updating, analyzing, displaying, and manipulating spatial data related to locations on the Earth (Mkhongi & Musakwa, 2020). GIS can also be defined as the applied geographically oriented computer technology, an integrated system used in substantive applications (Maguire, 1991). GIS is a geographic information system (GIS) application that is currently experiencing global growth and gaining significant interest worldwide (Musakwa, 2017). GIS is defined in terms of what it can do; for example, it can "manage geospatial information through gathering, editing, storing, converting, analysing and visualising geospatial data" (Fleischmann & van der Westhuizen, 2020).

In South African Secondary schools, GIS is a compulsory topic in Geography as part of the Curriculum and Assessment Policy Statement (CAPS) for grades 10-12 (Department of Basic Education, 2011). In the curriculum, GIS was introduced in 2006 as part of the National Curriculum Statement (Breetzke et al., 2011). GIS is one of the topics that learners have to know, but the application of the content is limited. GIS is introduced to learners in Grade 10, and as they progress from Grade 10 to Grade 12, they go deeper into the topic. In Grade 12, "Focus textbooks" or "Solution for all textbooks" are used by most schools to teach GIS. Generally, in SA, GIS is needed in many fields, from health to economics, to mention a few. GIS cannot be successful in all those fields if its education at school is not good (Fleischmann & van der Westhuizen, 2020). Research studies have been conducted on the application of GIS in schools. For example, a retrospective analysis was conducted on the application of GIS in schools worldwide, where the author analyzed the problems associated with incorporating GIS in schools (Kholoshyn et al., 2020). One of the studies conducted by (Hlatswayo & Manik, 2022; DBE, 2023) show that the plan to apply GIS in South African Secondary schools began in the 1990s; however, most countries are still struggling to implement the teaching of the topic and apply it. The other research conducted by Hong (2012) focused on integrating web-based GIS into the classroom. GIS web-based applications, such as ESRI GIS and Google Earth, were used as examples of how GIS can be introduced in the classroom. In that research, most teachers already in the education system complained that implementing GIS was challenging, as they did not have enough time to learn GIS and practice new technologies. One suggestion to address this challenge was that the curriculum for students still in higher education should teach future teachers about GIS (Hong, 2012).

Teaching GIS requires a learner-centered classroom setting, enabling learners to become actively engaged in their own learning. To understand and learn GIS effectively, various components are required: hardware, software, people, data, and information. Therefore, it should be taught in laboratories that encompass both theoretical and practical aspects (Hlatswayo, 2022). Most schools face numerous challenges in implementing GIS teaching, including a lack of resources and inadequate teacher training (Ontong & le Grange, 2018), overcrowded classes, and time constraints (Tarisayi & Zondi, 2020), among others. Researchers have taken various angles to understand why learners struggle with GIS, but not how Geography Textbooks present the topic and tasks to support learners' learning of GIS.

Textbooks are learners' important resource material, preferred mostly in schools. Textbooks as a resource material for teaching and learning create opportunities for learners and teachers to learn (Otieno & Povey, 2023). This means that the textbook is essential for understanding fundamental concepts. The opportunity to learn is determined by the textbook used. Textbooks reflect the curriculum intended for education (Hadar & Ruby, 2019). In a study conducted by Ogbonnaya (2023) on the use of textbooks for a challenging topic in Grade 10, she found that the textbook did not provide an effective learning opportunity. In this study, the conclusion was that the tasks presented in the selected textbooks were found to be dominated by lower-order cognitive skills, which may not be helpful for learners to develop higher-order cognitive and analytical skills. In one of the research studies on how textbook design influences learning with geography textbooks by Behnke (2016), the researcher analyzed the pictures, graphics, and texts used in the geography textbooks. In that study, it was concluded that learning geography requires a textbook with more visuals related to the content; however, this approach requires learners to have prior knowledge. In another textbook analysis, the researcher was checking how geography textbooks' tasks promote comparison competency. In this study, 20 textbooks from Germany, Berlin, England, and France were analysed using the theoretical competency model for comparison in geography education by the same researcher. The research concludes that there is a limited extent to which authors of the textbooks consider comparison as a competency (Xiang, et al, 2020).

Despite the importance of using GIS to improve learners' understanding of geography, the continued poor performance of learners in the GIS section in the matric examination is a cause for concern (DoE, 2018; Hlatywayo & Manik, 2022). Matric exams are the exit exams taken for grade 12 learners before they join a tertiary institution. In the study done by Ahiaku and Mncube (2018) on the factors that influences learners' performance in geography, it was concluded that factors that influence the low academic performance in geography during the National Senior Certificate examination are the teachers' qualifications and experience, teaching and learning facilities and materials, methods used to teach learners, language of teaching and learning, size of classes etc. Anlimachie (2019) found that the lack of a link between learners' everyday life experiences and the subject, as facilitated through activity-related field trips and practical exercises, makes it difficult for learners to pass the subject. Learning geography can become difficult for learners, and this may lead to poor performance if it is only taught inside the classroom (Anlimachie, 2019). Wilmot (2018) has investigated the poor performance of learners in Geography and found that GIS was the major concern for both learners and teachers. Learners were found to be passing the subject but not attempting to answer GIS questions (DBE South Africa, 2014b, p.89). Research on the GIS primarily focuses on its implementation challenges and the progress of countries in implementing GIS, leaving a gap in the role of textbooks. This study argues that a gap exists in the literature that fails to account for the opportunity to learn GIS provided to learners through geography textbooks. To close this gap, the study seeks to address the following research questions: *What opportunities to learn GIS from tasks are presented in the two Geography textbooks in the FET phase, and which Geography textbooks present a better OTL "GIS" from tasks?*

Literature review

Geography as a subject

Geography is a very diverse study discipline that first emerged as an academic discipline in the early 1900s, which is difficult to define, but geographers define it based on its sub-disciplines: physical geography, which focuses on the earth's biophysical environment, and human geography, which focuses on people (Rhoads, 2022). Defining Geography relies more on its function and nature in various fields, such as political, social, and economic (Vasegh et al., 2018). Geography is an academic discipline and a subject of study that explores and promotes critical thinking about how the world is organized, the environments and patterns that exist on the ground or that humans create in their minds, the interconnections that exist between the physical and human environment, and the nature of places and regions (Murphy, 2020). Geography can be defined in terms of the topics covered by the curriculum; hence, in the research conducted by Al-Nofli (2014) about learners defining the subject in their own understanding, most of them defined it in terms of themes, other skills aspects, other concept aspects, and other emerging themes like opinions (Al-Nofli, 2014). De Blij (2005) concurs that defining geography is a complex task because there is no exact definition of what it is. Hinde (2015) quoted the Royal

Geographic Society, defining Geography as "the study of Earth's landscapes, peoples, places and environments. It is, quite simply, about the world in which we live."

Most authors define Geography as a science, while some are opposed to this definition (Castree, 2005). Defining Geography as a science is a complex task because it involves calling something a science that requires proof. Proving phenomena in Geography is impossible, as geography deals with geographical space and time, which lacks empirical, social, and scientific validity. Geography is a beyond-science discipline, but the remaining question by the same author is what type of science is it? Some people still believe that geography is not a legitimate field of study, and others think that studying the subject will not lead to a job. Additionally, people often misunderstand geography for geology (Murphy, 2020).

In South Africa, according to the CAPS document, Geography is defined as the study of human and physical environments. It is an elective subject in Grades 10 to 12. Learners are first exposed to the basic concepts of the subject as early as grade 4 in social sciences. It is essential to study the subject because it addresses the environmental concerns of our era, such as climate change. It deals with transportation planning and land use. Geography is important for intelligence agencies using GIS and Remote Sensing.

GIS and its implementation

GIS acronym stands for Geographic Information Systems/Science/Studies/Services (Sui, 2015). GIS are computer systems based on hardware, software, and geo-referenced data that can be used to collect, store, manage, process, analyze, and visualize both spatial and non-spatial information representing real-world geographic phenomena (Rogers et al, 2024). GIS is a powerful geospatial tool that is used to explain the relationships between phenomena and the processes in space associated with them. Not only can GIS be used for this purpose, but it can also be utilized when planning trips, navigating the world, and tracking the weather (Osborne et al, 2020). According to Kerski et al (2013), GIS was first developed during the 1960s by the Canadian Land Inventory System. In its development, it has been primarily used in higher education; its use in secondary education was only considered in the 1990s. Kerski et al. (2013) analyzed 33 national curricula from different countries, discovering that only 8 of these countries had actually implemented GIS in their national curricula. South Africa was among the 8, along with China, Finland, India, Norway, Taiwan, Turkey, and the UK. In the research, a list of questions was asked of the participants from all those countries. A common theme among South African countries was the presence of GIS in their formal National Curricula, industry-university partnerships in secondary education, and local investigations on the country. The only challenge was the absence of Web GIS. South Africa, as one of the countries that incorporated GIS into its geography curriculum, was highly regarded because learners are exposed to the topic as early as grade 10. GIS was taught in the classroom without the hardware, using a paper-based GIS educational package.

Although the implementation of GIS in education is a desirable initiative, many countries face numerous challenges. A study by Osborne et al (2020) on the conditions for implementing GIS in the curriculum reveals that most teachers lack knowledge of the topic and its application with GIS and ICT tools. This is evident enough to prove that GIS is not taught well in schools as Fleming & Evans, (2021) and Hlatswayo & Manik, (2022) found the teaching of GIS to mainly based on teacher-centered approach. The other challenge was the limited time available for teaching the topic, which necessitated extra time. When it comes to the use of GIS tools, Google Maps is the most widely used one, and only a few teachers can effectively utilize GIS software. Most teachers prefer students to learn about GIS rather than to work with it practically. Barriers and challenges to the implementation of GIS include a lack of teaching materials and technical equipment, insufficient support for school management and parents, a lack of motivation among teachers to teach the topic, and a shortage of relevant qualifications to teach the topic. In the article about learning geography with GIS by Mbamalu (2024), there are two approaches to implementing GIS in education: Firstly, to acquire knowledge about GIS ("learning about GIS") and secondly to use it as a tool for solving geographic tasks ("learning with GIS "). "Learning about GIS" is about handling geographical data or managing geographical information.

"Learning with GIS" is about geographic knowledge and geographic intelligence. It takes two for the proper implementation of GIS in the curriculum.

GIS is a subset of map work that requires the use of ICT (DBE, 2011b). A study by Seedat (2019) focused on how geography educators perceive the use of ICT in teaching map-work and found that educators liked ICT and said that it improves their teaching, but the challenge is the lack of resources and educator ICT training, hence they keep on going back to rely on textbooks for the teaching of GIS. This relates to my study, which suggests that textbooks still serve as the primary resource for teachers and learners in the teaching and learning process.

Ahiaku and Mncube (2018) investigated the causes of poor performance in another study, exploring the perceptions of grade 12 teachers. It was found that some teachers had not been taught GIS at school, which led them to dislike the topic and struggle to teach it to learners. In this research, a case study research methodology was employed, following a purposive sampling approach, where six experienced geography teachers were asked to share their in-depth perceptions. The finding was that 2 teachers were happy with the way the GIS part is set on exams. The way questions are asked differs from the way learners were taught in the classroom. The exam question paper does not align with the resource, which, in this case, will be a textbook, since the examiners do not provide teachers with guidance on how GIS will be assessed. Another teacher complained about the complexity of the level of questioning, stating that examiners ask more practical questions, whereas he was expecting questions to be more textbook-based due to a lack of resources in schools. This simply shows that using a textbook to teach GIS is important, but it is insufficient, which requires a proper GIS exam guideline.

GIS in the curriculum

GIS was first introduced as part of the curriculum in South Africa in 2006, as part of the National Curriculum Statement (Breetzke et al., 2011). GIS is one of the topics in geography that falls under the aim of promoting the use of new technologies. The GIS topic is well-distributed throughout the Geography Annual Teaching Plan (2023/2024). In Grade 10, learners are introduced to the topic of GIS. They must learn about the basic concepts of GIS (for example, pixels, spatial objects, and scales), the components, the reasons for GIS development, and Remote Sensing, as well as how Remote Sensing works. In Grade 11, it is a continuation of Grade 10's work, with a review of concepts related to GIS, Remote sensing, and their applications. The application of GIS to climatology includes GIS data and the types of data (raster and vector), spatial and spectral resolution, and capturing different types of data from existing maps. In Grade 12, it is expected that the learner is now familiar with GIS, so a revision of Grade 10 needs to be done; then, new information that is added is concepts (data layering, buffering, data standardisation, data sharing, and security), and lastly, the application of GIS concepts.

THE USE OF TEXTBOOKS IN TEACHING AND LEARNING

In teaching and learning, a textbook is one of the most important resource materials. Teachers rely on textbooks as their main resource for the type of content they need to deliver to their learners (Glasnovic, 2018). There are numerous resources used to teach learners within the classroom, but the textbook is the most important, as it provides an opportunity for both teachers and learners to engage in the learning process. The textbook is the primary source for the content covered in the classroom and also helps determine the type of teaching style that should be applied when addressing the topic (Shakhislam et al, 2024)

Tasks from textbooks

In Geography textbooks, there is a need to determine the different cognitive levels of tasks that we use. Tasks refer to the activities that learners must complete, such as extracting questions from practice examination question papers in the textbook (Boston et al., 2017). Assigning learners tasks is an essential part of geography lessons because it engages them in the content (Kuiper, 2017). In a study by Krause et al. (2025), a geography task classification framework was employed to identify higher-order thinking tasks. According to this framework in geography, there are four task categories from low to high. The categories are Lower-Order-Thinking (LOT) tasks; Use-of-Thinking-Strategies (UTS) tasks; Parts-of-Higher-Order-Thinking (PHOT), and Higher-Order-Thinking (HOT). The framework is formulated based on Bloom’s revised taxonomy. In another study done by Glasnovic (2018), a 5D framework was established to examine the requirements in textbook tasks. The framework comprises content, mathematical activities, varying levels of complexity, answer forms, and contextual features. The result of that study showed a connection between the Opportunity-to-Learn provided by textbooks and learners’ achievement in the content. Contrary to this, Polat and Dede's (2023) study revealed that the tasks in the analyzed textbooks were generally of low cognitive demand and provided no opportunity to learn the concept from the textbooks. Textbooks serve as a source of tasks for students and are often considered the starting point for various activities. The tasks in textbooks influence learners' thinking about the subject; hence, it is essential that the textbooks used for different subjects are rich in content and feature well-structured tasks that are engaging for learners, challenging, and also provide opportunities for learning. Tasks need to be balanced and meet the demands of the cognitive levels. According to Wilson et al (2024), textbooks provide numerous learning opportunities and should be considered when evaluating students. In his study, Lee (2022) found that a low proportion of high-cognitive-level tasks in a specific textbook, and argues that tasks requiring students to engage in deep cognitive processes, mainly application tasks, should be sufficiently provided.

Using a revised Bloom's taxonomy, Şanlı's (2019) study in Turkey, which is similar to my study, examined the question types in a high school geography coursebook and found that open-ended questions and matching questions were the most frequently used question types in the coursebook. These questions primarily assess knowledge at the lower-order cognitive level. However, Ni et al. (2018) found that the frequency of tasks involving high-order cognitive demand did not predict cognitive learning outcomes, but had a positive influence on students' interest in learning mathematics and their classroom participation.

In another study, Mishra (2013) explored the nature of geography textbook questions and their role in assessment, finding that many questions (approximately 80%) focused on non-spatial concepts, while the remaining proportion focused on spatial concepts, maps, graphs, and diagrams. While Jo and Bednarz (2009) argue that adequate questions from textbooks improve learners' understanding of the content, help identify critical information, facilitate the development of strategies for processing the given information, and enhance learners' problem-solving skills, Engin and Sezer (2016), concur that a low proportion of tasks were presented in their mathematics textbooks and therefore did not help in improving learners' understanding of the concepts being taught. Machost and Stains (2023) argue, on the other hand, that reflective practices, such as metacognitive assessments and activities promoted by teachers, create cognitive pathways that consolidate conceptual understanding.

Geography textbooks analysis

Earlier studies on the knowledge analysis of Grade 12 Geography Textbooks used in South African Schools, as highlighted by Ngubeni (2009), have shown that the screening of school textbooks is conducted by the School Management Team, Subject Educators, and Subject Advisors. He concluded that learners' knowledge and performance in the subject appear to be related to the provision of textbooks. This study discusses several studies on textbook analysis, which collectively demonstrate that textbook analysis is a significant area of research conducted worldwide across all subjects. A similar study by Ngubeni (2009) analyzes GIS tasks in geography textbooks using Bloom's taxonomy and found that GIS tasks were not strongly presented to enhance learners' understanding of the concept. Anderson (2005) highlighted that attempts have been made to revise the original Bloom's taxonomy, reducing the six major categories to four. The limitations of Ngubane's study include the fact that the country is vast and that schools use a large number of textbooks, which may not be included in the study. In the conclusion of that study regarding the cognitive demand, the tasks were found to produce more facts without learners exploring their knowledge in the real world. The textbooks lacked more baseline and formative assessment activities for learners.

Behnke (2016) conducted another study on geography textbook analysis, focusing more on the design of the textbook (graphics, photos, text) and its influence on the subject. The findings from his study show that visual attention is considered an important stimulus to capture learners' attention and help them learn more about what the text is really about. Visual attention in the learning process helps learners to easily construct knowledge about the topic. The design of the textbooks captures the learner's attention, making it easier for them to acquire knowledge. The researcher agrees that textbooks should be developed with attention to design, because if not, the subject will be boring for learners. Just imagine having a textbook written in black and white, with no pictures, graphs, or infographics. That would be so boring for learners. The gap here is that the research focuses more on the textbooks' visuals rather than the tasks.

Opportunity-to- learn

Opportunity-to-Learn is a framework used to measure the likelihood of learning in educational research. This theoretical framework is characterized by three dimensions: time, content coverage, and instruction quality (Kurz, 2011). According to Ong et al. (2024), many authors have adapted the OTL to sample various aspects of teaching and learning, including teachers' qualifications, classroom management, content coverage, and instructional time. Cai et al. (2020) argue that classroom learning opportunities involve the interactions of tasks, teaching, and learners. Since there are various factors that provide opportunities for learners to learn, Jensen (2019) chose to focus on the Classroom OTL (COTL). In this study, 3 elements: local quality, generic quality, and instructional time were the ones influencing COTL. In his findings, those elements were found to be interdependent on each other, and that COTL should be sensitive to the area where the school is situated, the teachers, and the learners in that particular school; this means that there is no one-size-fits-all approach. Therefore, multiple assessments are necessary to comprehend the complexity of COTL across various settings.

Methodology

This study follows a qualitative research approach. The qualitative research approach is the systematic inquiry into social phenomena in natural settings (Teherani, 2015). This research approach enables the researcher to gain insight into the feelings, experiences, ideas, and actions of participants. It generates theories that explain data. Unlike the quantitative research approach, which deals with numerical values, the qualitative research approach is based on interpretivism, aiming to gain an in-depth understanding of human behavior by exploring the problems faced by people, as well as their beliefs and perspectives on those issues (Mantula, 2024).

An analytical content design, specifically qualitative content analysis, was employed in this study. "Content analysis is a research technique for making replicable and valid inferences from texts (or other meaningful matter) to the contexts of their use" (Krippendorff, 2018). Qualitative content analysis is a flexible technique commonly used in analyzing text data (Elo et al., 2014). Content analysis is the analysis of texts, images, and the symbolic content of all documented materials. In this study, the tasks in the geography grade 12 were analyzed to determine whether they provide opportunities to learn GIS or not. Different articles from 10 years ago on the topic were read to understand how to approach the research and the relevant information related to GIS generally.

The non-probability sampling technique used is convenience sampling. Convenience sampling is a sampling method where a researcher uses a sample that is readily available and also has access to (Golzar, 2022). This non-probability sampling method is based on ease of accessibility. Obtaining textbooks for this study is straightforward because the researcher has access to the textbooks at the school, and they are in the public domain. The data was collected from the two Grade 12 Geography Textbooks: Focus and Solutions for all. These are the commonly used textbooks when teaching Geography in South African schools. Textbooks are learners' important resource material, mostly preferred in schools. Textbooks serve as a valuable source of material for teaching and learning, providing learners and teachers with opportunities to engage in learning (Otieno & Povey, 2022). This means that textbooks are essential for understanding the content of basic topics. The opportunity to learn is determined by the textbook used. Textbooks reflect the curriculum that is intended for education (Hadar & Ruby, 2019).

A content analysis method was used to analyse the two textbooks using the Bloom Taxonomy (BT). The Bloom Taxonomy was developed in 1956 following informal meetings among college examiners that began in 1948. BT has been used to address the cognitive domain of tasks in textbooks. The taxonomy comprises six categories of cognitive skills, represented in a pyramid. The first category at the base of the pyramid is lower-order skills, and the last one at the top is higher-order skills. The categories, ranging from lower-order skills to higher-order skills, are Knowledge (e.g., Name), Comprehension (e.g., discuss), Application (e.g., Illustrate), Analysis (e.g., compare), Synthesis (e.g., justify), and Evaluation (e.g., design) (Seaman, 2012). The research analyzes the data by looking at whether the tasks in the textbooks are designed in relation to Bloom's taxonomy or not.

Findings

We discuss the study's findings, aligning with the research questions posed in this study. The first research question was: What opportunities to Learn "GIS" from tasks are presented in the two geography textbooks in the FET phase?

In Textbook 1, there are four tasks related to the GIS topic, and in Textbook 2, there are eight tasks. The questions in all those tasks range from different cognitive levels. For example, in one task, there will be low-order questions with just one high-order question. For example, in one task, there will be low-order questions with just one high-order question. Table 1 below shows the questions for different cognitive levels for both textbooks.

Table 1. Bloom's Taxonomy Cognitive Levels

	Textbook 1 (4 tasks)	***Textbook 2 (8 tasks)***
Lower-Order Cognitive Level		
1. *Knowledge*	15	21
2. *Comprehension*	14	9
3. *Application*	2	0
Higher-Order Cognitive Level		
4. *Analysis*	0	1
5. *Synthesis*	6	2
6. *Evaluation*	4	8
TOTAL QUESTIONS	**41**	**41**

The OTL to learn GIS from the Tasks in both textbooks

Lower-Order Cognitive Levels

1. *The knowledge level:* On textbook 2, 21 questions were presented with verbs such as mention, name, list, etc. This suggests that the OTL tasks from textbook 2 are primarily

based on the knowledge level and, as such, do not encourage learners to think critically about the application of GIS. Textbook 1 presented 15 questions, which makes it fewer in comparison to textbook 2.

2. *The Comprehension level:* The number of questions on Comprehension presented in textbook 1 is 14, and in textbook 2, there are 9 questions on the topic of GIS. These questions primarily focused on discussing and explaining.

3. *The Application level:* There are 2 questions on this level in textbook 1 and 0 in textbook 2.

Higher-Order Cognitive Levels

4. *The Analysis level:* Only 1 analysis question in textbook 2 and 0 in textbook 1.

5. *Synthesis Level:* Textbook 1 shows 6 questions about this level, while Textbook 2 shows 2. The questions like create and make.

6. *Evaluation Level:* Textbook 2 presented 8 questions, and Textbook 1 presented half of those questions. The questions primarily concern justification and suggestion.

These findings showed that the frequency of tasks at the higher-order cognitive level is fewer than those in the lower-order cognitive level

To address the second research question, which states: which Geography textbooks present a better OTL "GIS" from tasks in the geography phase?

Tasks in both textbooks are not satisfactory because they do not address all cognitive levels thus, teacher-centered approach of teaching GIS was perceived to dominate the teaching of this concept due to limited tasks presented to engage learners to understand the concept of GIS. There are lower-order cognitive skills questions in both textbooks, and fewer higher-order cognitive skills questions. Neither textbook provides a better opportunity to learn about GIS.

Discussion

One of the findings in this study is that teachers' approach the teaching of GIS in a teacher-centred way mainly limited to lecturing and explaining the content without incorporating the opportunity to learn GIS from the textbooks. This finding aligns with that of Fleming & Evans, (2021) and Hlatswayo & Manik, (2022) who found the teaching of GIS to mainly based on teacher-centered approach.

The key finding from both textbooks is that most tasks in both textbooks fall under the category of Lower-Order Cognitive Skills (LOCS). It is important to establish that in the context of this study, 'tasks' and 'questions' are used interchangeably and mean the same. There are a few questions on the higher-order cognitive level that do not make sense at all, as GIS is a topic of application. This finding aligns with that of Lee (2022), who found that a low proportion of high-cognitive-level tasks in a specific textbook implies that tasks requiring students to engage in deep cognitive processes, mainly the application tasks, were insufficiently provided. At the application level, there are two questions for textbook 1 and no questions for textbook 2. This means that, as much as GIS is an application topic, neither textbook can effectively cater to assisting learners in applying what they are learning about, which is a concern. Both textbooks' questions in those activities are equal, with 41 questions for each.

It is evident that there is still a long way to go in the GIS topic in general, as the tasks presented in both textbooks on the topic are relatively low. There are fewer tasks addressing the topic, and those tasks are not practical, requiring learners to become practically involved in learning about GIS through computer use. Our finding is consistent with that of Engin and Sezer (2016), who found that a low proportion of tasks were presented in their mathematics textbooks. This underrepresentation of high-level cognitive tasks suggests a need to improve on textbook content to better support the development of learners' higher-order thinking skills. Although we emphasize practical tasks with higher-order tasks due to the nature of GIS, it is, however, important to strike a balance between lower-order and higher-order cognitive tasks in order not to miss the opportunity to engage learners in complex and meaningful thinking. Our findings showed that neither textbook provides a better opportunity to learn about GIS. This finding is consistent with that of Polat and Dede (2023), who revealed that the tasks in the analyzed textbooks were generally of low cognitive demand and provided little or no opportunity for learning, but contrast with the findings of Glasnovic (2018), who found a connection between the Opportunity-to-Learn provided by textbooks and learners' achievement in the content. Although our findings indicate that the frequency of tasks at the higher-order cognitive level is fewer than those in the lower-order cognitive level, one cannot conclude that the cognitive learning outcome positively or negatively influences learners' interest in learning GIS and classroom participation. This finding contrasts with that of Ni et al. (2018), who found that the frequency of tasks involving high-order cognitive demand did not predict cognitive learning outcomes but had a positive influence on the students' interest in learning mathematics and their classroom participation.

Another finding from this study is that tasks presented in the lower-order cognitive level are mainly in the knowledge level of 'mention', 'name', and 'list', which are not reflective practices that can be promoted by teachers and therefore do not develop learners' conceptual understanding of the concept "GIS" and create cognitive pathways. This finding aligns with that of Machost and Stains (2023), who argue that reflective practices, such as metacognitive assessments and activities promoted by teachers, create cognitive pathways that consolidate conceptual understanding.

As explained earlier, GIS is a computer-based system that utilizes hardware, software, and other components. In Grade 12 geography, four chapters are taught to learners: Climate and Weather, Geomorphology, Settlement, and Economic Geography (Annual Teaching Plan, 2025). In every chapter, there is a section on map skills and GIS, and tasks related to GIS are supposed to be included in all chapters; however, according to the analysis, this is not the case. In Textbook 1, the tasks are not chapter-focused; rather, they are too general, focusing more on lower cognitive-level knowledge and comprehension. The questions in that textbook primarily focus on climate and weather. Textbook 2 tasks are also general, but there is at least one 3-task that addresses the chapters.

Learners in grade 12 are assessed on the topic of GIS, which accounts for almost 8 marks out of 150 marks. As stated in the problem statement above, learners not responding to GIS creates a major concern, which is evident in how the topic is represented in those textbooks. GIS content in both textbooks will only help learners in answering low-order cognitive level questions, mostly because there is little to no representation that will assist learners in answering high-order cognitive level questions. In Textbook 1, all content related to GIS for the entire year is covered from page 29 to page 49, and in Textbook 2, it is from page 46 to 59.

Conclusion

In conclusion, neither of the textbooks provides the opportunity to learn GIS. This is due to the analysis that revealed that all tasks in both textbooks are predominantly of lower-order cognitive levels. The textbook tasks do not allow learners to apply the content practically using the computer-based system, as they should. This textbook's approach to the topic is similar to that of any other chapter in geography; however, it is more theoretical than practical. The recommendation would be for textbook publishers to publish a textbook specifically designed for teaching GIS, featuring numerous practical tasks that cater to various cognitive levels. The study is significant because it will enable curriculum advisors to thoroughly examine the textbook's content before approving and recommending it for use in schools for teaching and learning. GIS is a crucial topic in geography that is gaining worldwide significance, and it needs to be taught effectively to learners so that they can develop a passion for it at an early stage, before entering higher education institutions. It would be only fair that learners' practical engagement with the topic be promoted to foster GIS growth. The study emphasizes the need for a more strategic approach in designing and selecting GIS tasks in geography textbooks that will give enough opportunities to learn the topic in future textbooks. The research is useful to the Department of Education in informing textbook choices and to the subject specialists on implementing the application of GIS in schools, thus making the subject more engaging and easier for learners to understand.

References

Ahiaku, P. K. A., & Mncube, D. W. (2018). Geography educators' perceptions of learner performance in Grade 12 geography in public schools. *Alternation*, (21), 68–90.

Al-Nofli, M. A. (2014). Omani students' definitions of geography. International Research in Geographical and Environmental Education, 23(2), 166–178. https://doi.org/10.1080/10382046.2014.927167

Anderson, L. W. (2005). Objectives, evaluation, and the improvement of education. Studies in Educational Evaluation, 31, 102–113. https://doi.org/10.1016/j.stueduc.2005.05.004

Anlimachie, M. A. (2019). Enacting relevant basic education to bridge the rural–urban inequality in Ghana: The prospects and approaches for investigating rural educational realities. *International Journal of Humanities and Social Sciences, 11(1), 42–58.*

Behnke, Y. (2016). How textbook design may influence learning with geography textbooks. *Nordidactica: Journal of Humanities and Social Science Education,* (1), 38–62.

Breetzke, G., Eksteen, S., & Pretorius, E. (2011). GIS-based: A practical answer to the implementation of GIS education into resource-poor schools in South Africa. Journal of Geography, 110(4), 148–157. https://doi.org/10.1080/00221341.2011.583293

Boston, M. D., Madler, K., & Cutone, C. (2017). Implementing tasks that promote reasoning and problem solving. In D. A. Spangler & J. J. Wanko (Eds.), Enhancing classroom practice with research behind Principles to Actions (pp. 13–26). National Council of Teachers of Mathematics.

Cai, J., Morris, A., Hohensee, C., Hwang, S., Robison, V., Cirillo, M., Kramer, S. L., Hiebert, J., & Bakker, A. (2020). Maximizing the quality of learning opportunities for every student. *Journal for Research in Mathematics Education,* 51(1), 12–25. https://doi.org/10.5951/jresematheduc.51.1.0012

Castree, N. (2005). Is geography a science? In N. Castree, A. Rogers, & D. Sherman (Eds.), Questioning geography: Fundamental debates (pp. 57–79). Blackwell Publishing.

De Blij, H. (2005). Why geography matters: Three challenges facing America: Climate change, the rise of China, and global terrorism. Oxford University Press.

Department of Basic Education. (2023). National curriculum statements Grades R–12: 2023 annual teaching plans (FET). https://www.education.gov.za/Curriculum/NationalCurriculumStatementsGradesR-12/2023ATPsFET.aspx

Elo, S., Kääriäinen, M., Kanste, O., Pölkki, T., Utriainen, K., & Kyngäs, H. (2014). Qualitative content analysis. SAGE Open, 4(1), 1–10. https://doi.org/10.1177/2158244014522633

Engin, Ö., & Sezer, R. (2016). Comparison of 7th grade mathematics textbook and program activities' cognitive demand levels. *Buca Faculty of Education Journal*, 42, 24–46.

Fleming, B., & Evans, M. (2021). An evaluation of the use of GIS and open data in secondary school education in South Africa, with reference to QGIS and OpenStreetMap (OSM). *Journal of Geography Education in Africa,* (4), 23–57. https://doi.org/10.46622/jogea.v4i1.2038

Fleischmann, E., & Van der Westhuizen, C. (2020). The educational research landscape on GIS integration and challenges—Globally and in South Africa. *Journal of Geography Education in Africa,* 3, 63–80.

Glasnovic, G. D. (2018). Requirements in mathematics textbooks: A five-dimensional analysis. *International Journal of Mathematical Education in Science and Technology*, 49(7), 1003–1022. https://doi.org/10.1080/0020739X.2018.1423856

Golzar, J., Noor, S., & Tajik, O. (2022). Convenience sampling. International Journal of Education & Language Studies, 1(2), 72–77.

Hadar, L. L., & Ruby, T. L. (2019). Cognitive opportunities in textbooks. *Mathematical Thinking and Learning, 21(1), 54–77.* https://doi.org/10.1080/10986065.2019.1564969

Haggarty, L., & Pepin, B. (2002). An investigation of mathematics textbooks in English, French, and German classrooms. *British Educational Research Journal,* 28(4), 567–590.

Hinde, E. R. (2015). Geography matters. *Journal of Social Studies Research,* 39(2), 55–62. https://doi.org/10.1016/j.jssr.2014.07.003

Hlatswayo, J., & Manik, S. (2022). Teaching geographic information systems (GIS) in South African high schools in the Frances Baard District. *Universal Journal of Educational Research,* 10(5), 334–348. https://doi.org/10.13189/ujer.2022.100503

Hong, J. Y. (2012). Why do some beginning teachers leave the school? *Teachers and Teaching*, 18(4), 417–440. https://doi.org/10.1080/13540602.2012.696044

Jensen, B., Martínez, M. G. P., & Escobar, A. A. (2019). Framing and assessing classroom opportunity to learn. In Educational assessment in Latin America (pp. 149–172). Routledge.

Kerski, J. J., Demirci, A., & Milson, A. J. (2013). The global landscape of GIS in secondary education. *Journal of Geography,* 112(6), 232–247.

Krippendorff, K. (2018). Content analysis: An introduction to its methodology (4th ed.). SAGE Publications.

Ngubeni, T. D. (2009). A knowledge analysis of Grade 12 geography textbooks (Unpublished master's thesis). University of KwaZulu-Natal.

Seaman, M. (2012). Bloom's taxonomy. Curriculum and Teaching Dialogue, 13(1–2), 29.