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The level of geography teachers' preparedness on the interpretation of geomorphological maps in secondary schools

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Abstract
To teach geography at school level properly, teachers are required to be masters of the subject content. However, most geography teachers do not show confidence and ability to teach geomorphology and maps. Hence, with the study reported on here, we aimed to examine the level of geography teachers' preparedness on the interpretation of geomorphology on maps. We followed a qualitative approach to examine the preparedness of teachers in Moletlane secondary schools in the Limpopo province of South Africa, to teach the interpretation of geomorphological maps. A case study research design with an interpretivist paradigm was used. Purposive sampling was applied to select 7 participants who have been teaching geography in Grades 10 to 12 for the past 10 years. Data were collected through individual semi-structured interviews, classroom observations, and document analysis. Kolb's learning theory was used as a theoretical lens to examine the preparedness of geography teachers on teaching the interpretation of geomorphological maps and themes that emerged from the data. The study reveals that most geography teachers did not have a proper understanding of geomorphology content to teach learners how to interpret drainage basins, fluvial processes, catchments, and river management using maps. Furthermore, most teachers did not know what geography skills were required to teach learners to identify, record and interpret the content on maps. Therefore, geography teachers need to be equipped with knowledge of how geomorphology and maps can be taught simultaneously. We recommend that geography teachers use YouTube videos for observation of the fluvial processes and engage in monthly professional learning communities (PLCs) and circuit workshops to clarify the confusion of the interpretation of geomorphology content and maps through the facilitation of educational specialist. This article contributes to the existing knowledge on the teaching and learning of geomorphology and map work in the geography curriculum.

Keywords: geography teachers; geomorphology; interpretation of fluvial concepts; level of preparedness; maps; secondary schools

Introduction and Background of the Study
The teaching of geography requires knowledge of the content on both geomorphology and maps for better transference of the required skills to learners. Scholars like Utami, Zain and Sumarmi (2018) distinguish three levels of geography teachers' preparedness: high, moderate and low. They describe the high level as a representation of an approach to critical geography topics that involves knowledge and crucial skills for addressing issues. The moderate level involves understanding human-environment interaction through cause-and-effect linkages. The low level is about the ability to identify a place or a location. Knowledge of the content on geomorphology and maps measures the quality of a teacher and the teacher's preparedness in the classroom. Therefore, geography teaching requires an interlink between geomorphology content and map work. Without a link between the content and maps, teachers' unpreparedness becomes exposed.

The concept of map work refers to a theme in geography that helps learners understand the spatial areas of natural land and its features (Steggink, 2021). Map work consists of understanding concepts and practicing map skills, which are applied when working with maps, sketching maps, or applying vertical exaggeration (Havelková & Hanus, 2019). However, geography takes a broad perspective and interprets the action and integration of all physical factors in geomorphology in relation to the problems that humans experience on Earth. Scholars like Vasileva (2019) describe geography as the foundation of all subjects, emphasising the integration of geomorphology and map work. In a nutshell, geography resorts under social sciences, and some teachers lack a mathematical background, which makes it difficult to master and teach map work.

In Türkiye, the content of geography in the 2025 secondary school map work curriculum is referred to as geographic skills and practices. Yalçınkaya and Karaca (2021) assert that practices comprise map skills and the use of primary and secondary information resources. Tan-Şişman and Karsantık (2021) state that in Türkiye, teachers are not provided with curriculum support, especially in public schools, but they are still expected to implement the policy. These variances have rendered geography map work ineffective, which, at the end of teaching and learning activities, affects Turkish learners' academic attainment.

Some learners are unable to interpret the geographical content on maps, and teachers also fail to deliver the knowledge and skills required for interpreting geomorphological maps. This shows the unpreparedness of such teachers to teach geography. Yunisa (2023) found that many geography teachers in Türkiye still failed to use audio-visual material during lessons to help learners understand geographic topics. A shortage of materials, such as digital data, software, and instruction creates barriers to the interpretation of geomorphological content and map work.

In a study conducted in secondary schools in the northern part of Nigeria, a lack of interest in geography was found, which was attributed to unqualified teachers and the time allocated to geography teaching (Ogunode, 2020). Hence, teachers in Nigerian schools were not prepared for teaching map work, which resulted in poor interpretation of geomorphological maps.

In South Africa, the reading, analysis, and interpretation of South African topographic (1:50,000) and orthophoto (1:10,000) maps is a problem for most geography teachers and learners. This is shown by the poor marks that learners have obtained in interpreting fluvial concepts and processes on maps. As indicated in the diagnostic report, most learners performed below average on Papers 1 and 2 in Grade 12 geography (Hughes, Meyer & Mphuthi, 2022). This shows that in South African secondary schools, the interpretation of geomorphological concepts and processes on maps contributes to the poor teaching and learning of the subject because it is not adequately taught. Therefore, this study was guided by the following research question: What is the level of geography teachers' preparedness for interpreting geomorphological maps in secondary schools?

Literature Review

The level of national and international geography teachers' preparedness to teach geography

Most teachers struggle with the basics of teaching the interpretation of concepts on geomorphological maps, which prevents learners from mastering these skills and attain good results (Huggett & Shuttleworth, 2022). Seedat (2019) argues that teachers are unable to read and interpret spatial information about landforms on maps, because of a lack of training. Additionally, they struggle to identify slopes and landforms on contour maps for the same reason. However, these findings raise questions about teachers' knowledge of teaching map work and their ability to demonstrate mathematical proficiency. This implies that teachers should not only be able to read but also understand how to interpret concepts and processes on geomorphological maps. They should be able to recognise the relationship between spatial information and mathematical references (Young, Levine & Mix, 2018). Scholars like Felix (2021) acknowledge that teachers are challenged by a lack of proper knowledge and skills in geographical concepts to teach map reading and interpretation. This negatively affects learners and further contributes to the misunderstanding of concepts and geomorphological processes.

Teachers who are challenged by the subject content and lack geographical skills, such as map reading, analysis, and interpretation, skip this content and tackle easier topics (Arnold & Mundy, 2020). Such teachers are not prepared to teach the interpretation of concepts on geomorphological maps. On the other hand, some teachers are unable to complete the prescribed content in time and are unable to help learners interpret concepts and processes on geomorphological maps due to the teachers' unpreparedness (Heath & O'Donoghue, 2021). As a result, geography teachers teach only certain topics, neglecting other significant geography topics. As Ockhuizen (2018) notes, in terms of preparedness, teaching, and learning, geography teachers may not be accountable for learners' contributions, efforts, and interests in the field.

The professionalism of geography teachers

Geographic map work requires of teachers to teach statistical analysis and evaluation skills to help learners interpret geomorphological concepts and processes on maps. In Türkiye, teachers are unable to use the technology devices provided to schools, raising the question of whether schools are sufficiently equipped to enable learners to understand the interpretation of concepts on geomorphological maps (Sözen & Korur, 2019). The failure to apply technological knowledge reveals teacher's lack of preparedness to teach the content.

Geographic content and geomorphological maps are currently being transferred from paper to digital form. Therefore, schools and teachers must stay abreast of new technological developments to adapt to modern ways of teaching. This mindset can be useful if institutions involved in education, local authorities, schools, teacher training institutions, and the Ministry of Education take a collaborative approach. A lack of collaboration leaves learners without a proper foundation and without a proper understanding of the interpretation of geomorphology concepts and processes on maps (Pitty, 2020). Additionally, the attitudes developed by teachers create problems for learners in grasping the techniques for the interpretation of content on geomorphological maps. Teachers' inability to integrate or incorporate the content with map work results in the failure to interpret concepts and processes on geomorphological maps. Kaya and Aladağ (2024) argue that teachers' attitudes and perceptions have a negative impact on the learning

of the interpretation of concepts on geomorphological maps. Tunc Sahin (2021) posits that most geography teachers struggle with the content and experience more difficulties with map work than with any other geography content. These create attitudes, perceptions, and negative views about the content to be taught.

Havelková and Hanus (2018) assert that teachers hold different views on why their learners have poor map skills. Generally, they state that the learners' readiness is very low, and that they do not have a good command of spatial and directional knowledge. Kamil, Utaya, Sumarmi and Utomo (2020) deduce that some geography teachers develop attitudes toward learners after the recognition of failure in the interpretation of concepts, processes, and features on maps. This results in most teachers not focussing on or work towards the goal of enabling all learners to interpret the content of geomorphological maps.

Teachers' geography qualifications

Filgona and Sakiyo (2020) argue that most schools in Nigeria have unqualified geography teachers, which affects learners in the Senior Phase. This is influenced by teachers who do not hold the required qualifications to teach geography. Additionally, Mogbo (2023) states that employed geography teachers lack map knowledge and skills, which affects learners and results in the misinterpretation of map concepts, which results in learners failing to understand geography. All teachers with limited knowledge of geography content and map work are urged to seek training to be eligible to teach the subject in accordance with the requirements for the teaching of geography.

Filgona and Sakiyo (2020) state that teachers contribute marginally to learners' academic achievement. Therefore, if most of the teachers responsible for teaching the subject lack subject knowledge, specifically on the teaching and interpretation of geomorphological concepts on maps, it is likely that teachers lack interpretation skills of geography concepts. This may prevent an entire cohort of learners from having interpretation skills.

Some geography teachers in South African schools are equipped with knowledge of map work. For those who do not understand the two topics, teaching learners presents various challenges, of which failing to deliver the curriculum (Tan, 2021) is the worst. Scholars like Mukondeleli (2018) admit that the foundation of concepts stems from the acquired knowledge of the content, but some South African teachers do not acknowledge the challenges or difficulties regarding the teaching of geomorphological concepts and the interpretation and analysis of maps. Therefore, the introduction of professional learning communities (PLCs) in schools, where teachers share their expertise rather than wait for workshops arranged by subject specialists, is mandatory in South Africa as part of the continuous professional teacher development programme. Moreover, teachers need to apply technology to enhance geography teachers' preparedness for interpreting geomorphological maps in secondary schools. Watching YouTube videos will develop self-confidence regarding the skills needed to teach the content.

Theoretical Framework

J Kolb's experiential learning theory was used as a lens for the study since it focuses on how teachers can be prepared to teach geomorphology and maps (Kolb, J 1974). The theory emphasis the learning style that needs to be followed by teachers and learners. J Kolb (1974) views learning as the foundation of the teaching experience. This is shown in the way in which styles integrate with others in the teaching and learning of geography. The theory further describes the four learning styles as diverging, converging, assimilating, and accommodating. The theory shows how experience is translated into concepts, which in turn is used as a guide for active experimentation and the choices of new experiences. In the context of geography teaching, the common practice, grounded in experience within the environment, is to start with theory before practice (Malatji & Singh, 2018). Additionally, J Kolb (1974) confirms that the environment has a greater influence on how individuals learn, particularly in subjects like geography.

Diverging (feeling and watching)

For this learning style, teachers need to consider learners' feelings about learning when planning lessons. Researchers such as Malatji and Singh (2018) argue that learners learn differently, and their feelings need to be considered. According to DA Kolb (1984), learners who learn according to this style, learn through watching and teachers need to change their teaching style to accommodate such learners.

According to DA Kolb (1984), diverging means to gather information after brainstorming to form a concrete idea. In the context of the teaching and learning geomorphological maps, teachers lack knowledge of reading and interpreting map content and a mathematical background, which can hinder successful teaching and learning. Hence, teachers fail to provide learners with the expected knowledge (Özdemir & Kaptan, 2017). Therefore, proper teamwork among teachers needs to be emphasised to allow learners to understand the interpretation of geomorphological concepts and processes on maps.

Assimilating (watching and thinking)
People with an assimilated learning style prefer clear explanations rather than practical platforms (Kolb, DA 1984). In the context of geography teaching, teachers should teach learners how to apply theoretical knowledge to practical questions in map work, but learners are not shown how to interpret the concepts on maps (Mewborne & Mitchell, 2021). DA Kolb (1984) emphasises that teachers need to focus more on practical than theoretical knowledge in all areas of geography and other sciences.

Converging (doing and thinking)
Geography teachers with converging learning styles think about possible alternative solutions before they attempt to solve problems or draw conclusions (Bockenkamp, 2019). They tend to find solutions to practical issues such as river profiles. Furthermore, they focus more on subject-related activities than on the individual needs of learners in the classroom. Geography teachers who adopt a converging style use practical strategies to solve problems and make informed decisions (Vermote, Aelterman, Beyers, Aper, Buysschaert & Vansteenkiste, 2020).

Accommodating (doing & feeling)
People who have an accommodating learning style rely more on their instincts and reasoning than on logic (Black, 2018). Geography teachers who are accommodating use other people's analyses based on their experiences to find solutions to new challenges. They use their instincts to attach meaning to the observed problem. Geography teachers with this learning style should teach geomorphological concepts and interpret each concept to accommodate all learners in the classroom. An accommodating learning style focuses on analysing existing information rather than on personal experiences or analysis (Kolb, AY & Kolb, 2005). This entails that teachers need to apply various pedagogical approaches to accommodate individual learners' understanding of drainage basins, fluvial processes, catchments, and river management.

Methodology

We used J Kolb's (1974) experiential learning theory as a framework to confirm the findings of the study. We used the qualitative research approach and the interpretivist paradigm which enabled us to qualitatively articulate the question of the level of geography teachers' preparedness in interpreting geomorphological maps (Merriam & Grenier, 2019). A multiple case study research design was used, as we focused on six secondary schools with teachers with more than 5 years of teaching experience in geography. In all the schools observed, direct contact with participants was made through individual semi-structured interviews, classroom observations, and document analysis to examine the level of geography teachers' preparedness in interpreting geomorphological maps. We used classroom observations to examine how teachers taught the interpretation of geomorphological concepts and processes on maps. We analysed documents such as lesson plans and worksheets on the interpretation of geomorphology and map work as additional information to determine the need for confirmation and clarification of the views stated by participants. The discussion of the findings is guided by the themes that emerged from the data and was supported by existing literature. The key findings were revealed by cross-checking and coding (Yin, 2018).

In reporting the findings, we used the codes indicated below to refer to the participants to ensure their anonymity:

- Geography teacher 1 school A – (GT1SA).
- Geography teacher 2 school B – (GT2SB).
- Geography teacher 3 school C – (GT3SC).
- Geography teacher 4 school D – (GT4SD).
- Geography teacher 5 school E – (GT5SE).
- Geography teacher 6 school F – (GT6SF).
- Geography teacher 7 school G – (GT7SG).

Results

The level of geography teachers' preparedness for interpreting geomorphological maps is determined by the knowledge and skills that they must teach in geography. The focus of the study was on the level of geography teachers' preparedness to interpret geomorphological maps in secondary schools. Geography teachers were interviewed and observed, and the lesson plans were reviewed to determine the teachers' preparedness to teach the interpretation of geomorphological maps. The following sub-themes and issues were raised: geography skills, prior knowledge, required geomorphological knowledge and strategies stipulated in policies. The discussion below is guided by these sub-themes and issues.

Discussion

Main Theme: Knowledge and Skills for the Interpretation of Geomorphological Maps

Drainage basins, fluvial processes, catchment, and river management

From the main theme, the following sub-themes emerged: geography skills, prior knowledge, required geomorphological knowledge, and strategies stipulated in policies. Each sub-theme is discussed below.

The level of preparedness for the teaching and learning of geography reveals how well teachers are equipped with content knowledge and skills to teach the subject. Regarding the teaching of interpretation of geomorphological maps, teachers should possess skills such as map reading, analysis, interpretation, and evaluation to equip learners to deduce geomorphological content from maps.

Learners who lack the above-mentioned knowledge and skills are likely to lack the ability to read maps and the motivation to apply more effort in understanding geography (Kolb, J 1974).

Geography skills

Not all teachers are regarded as experts, specialists, or lifelong learners and researchers. A lack of knowledge, or the content gap, limits teachers' skills in teaching geography. The mastery of teaching revolves around the knowledge and skills that need to be passed on from one generation to another, but unfortunately, some teachers do not have a good background in geomorphology to develop these skills. The participants said the following:

> *I only master map work calculations, and I am better at map work than at teaching geography content* (GT5SE).
>
> *I don't have any skill, but I think my interaction with learners speaks volumes, especially when interpreting geomorphology on maps* (GT6SF).
>
> *I don't think I have a skill regarding the teaching of interpretation of geomorphological maps because learners are failing the question; therefore, I cannot declare that I have skills* (GT7SG).

The above shows that most teachers believed that they lacked the skills because learners did not respond well to lessons on interpreting geomorphological maps. Teachers could not teach fluvial processes, drainage basins, catchments, and river management using topographic and orthophotography maps. Consequently, the teachers felt that without strong interpretive skills, effective teaching of fluvial processes, drainage basins, catchments, and river management would lead to poor scholastic results. Therefore, the teachers identified a need for videos and additional textbooks to enhance their ability to effectively teach the interpretation of geomorphological content on maps. Another participant believed that their skills of interacting with learners did not yield the expected outcomes, which calls for a change of teaching approach. According to DA Kolb (1984), the convergent style allows learning through abstract conceptualisation and active experimentation. We emphasise that, through active experimentation, geography teachers should possess the above-mentioned skills to equip learners with the knowledge and skills to provide descriptions and explanations of the interrelationships between physical and human geography. The skills should not only be applied to individual topics but to all sections of the geography curriculum (Alazmi, 2024).

Prior knowledge

Prior knowledge refers to the content acquired from geomorphology and maps. Geography teachers need a basic understanding of geomorphology to help learners understand the subject content. As the data reveal, most geography teachers found it difficult to teach geomorphology and map work. Prior knowledge of geomorphology includes the basics about slopes, rocks, and landforms. Additionally, the knowledge should align with the content to be taught in the current lesson. The *Curriculum and Assessment Policy Statement* (CAPS) for geography indicates that teachers are obliged to move from simple to complex content. The participants responded as follows in this regard:

> *I think learners need to be exposed to the things they know before they can get into the details of geomorphology and maps* (GT1SA).
>
> *Firstly, they must understand their local environments, such as rivers and vegetation, that are found in areas* (GT4SD).
>
> *They need to know the basics of maps before they acquire knowledge of the content* (GT5SE).

The participants' views show that learners need basic knowledge and skills to unlock the key to interpreting geomorphological maps. DA Kolb's (1984) theory confirms that the environment allows teachers to use the local area as a reference point to give learners a clear view of how geomorphological concepts and processes relate to the maps given in the classroom. In simple terms, one can argue that teachers need to build strong foundations of geomorphology and map work to ensure that learners are prepared well when they progress to the next grade. This allows teachers to provide learners with essential knowledge about their place and world, which contributes to their personal development and equips them with specialised skills (Deng, 2018). Sant, Davies, Pashby and Schultz (2018) state that prior knowledge develops learners' understanding of issues in a geographical context, which is essential for informed citizenship.

Required geomorphological knowledge

To show that teachers are well-equipped to teach the interpretation of geomorphological maps, focus should be on learners' understanding of geomorphology and maps. In geography it is necessary to understand, record, and analyse to interpret geomorphological processes on topographic and orthophotography maps. In response to the question on equipped knowledge, the participants responded as follows:

> *I consult with colleagues in geography teaching and learning to get more knowledge about geomorphology and map work* (GT1SA).
>
> *I don't think we are well-equipped with the required knowledge because the educational specialists come to monitor the content, progress of work, and whether learners are passing the content, but we have never had an educational specialist supporting us on how to teach the content on geomorphological maps*. (GT3SC)

The participants believed that teachers were not well-equipped with the required knowledge and

skills for geomorphological maps, as they consulted with other colleagues in the field. The participants emphasised that their lack of preparedness stemmed from a knowledge-focused approach in which content and work progress is prioritised over providing in-depth, constructive feedback on effectively teaching the interpretation of geomorphological maps. Mhishi, Chimbwanda and Gwizangwe (2023) argue that teachers who possess geography knowledge are responsible for capacitating, organising, and preparing lessons for the teaching of geography. This is supported by DA Kolb's (1984) theory, which holds that both teachers and learners learn from experience.

The strategies prescribed by policy

The CAPS stipulates different strategies to assess learners' understanding of the interpretation of geomorphological maps. The strategies refer to a plan for achieving goals in teaching and learning, including peer teaching and assessment. The stipulated strategies are emphasised to achieve the desired knowledge and skills, on which the participants responded as follows:

> *I teach the whole group in the classroom to allow the group to diverge and learn from one another after the lesson* (GT1SA).
>
> *I encourage learners to be creative and critical thinkers when approaching topics such as geomorphology and map work. In addition, I think CAPS encourages fieldwork* (GT2SB).
>
> *I assess learners based on the topic and then assign the work to their group. By doing that, I can observe the challenges from different individuals in groups regarding the question* (GT3SC).

From the above we see that the participants thought that most teachers used a group approach to allow learners to share different ideas about the content and interpretation of geomorphological maps. According to participants, the implemented strategy allowed the teachers to observe challenges arising from the content taught in the classroom. However, some teachers encouraged learners to be creative and critical thinkers. Nkuna (2020) argues that teachers must incorporate a variety of teaching strategies in their classrooms because it will allow them to determine whether learners understand the concepts of the subjects and align their teaching to support success in interpreting geomorphological maps. The findings align with DA Kolb's (1984) view that teachers are obliged to use more than one strategy to give constructive feedback to all learners in geography classrooms.

Conclusion

We conclude that teachers need to be equipped with knowledge on the teaching of geomorphology and maps. Geography teachers' knowledge and skill are significant in the teaching of the interpretation of geomorphological maps. Without subject knowledge and teaching skills, teachers will never be prepared to teach the application of geography content on maps. This means that geography teaching still requires more from teachers to improve their approach to teaching the interpretation of concepts and processes, such as drainage basins, fluvial processes, catchment, and river management, using geomorphology on maps.

Professional Learning Communities

We recommend that teachers use YouTube videos on map work, PLCs, and circuit workshops to clarify confusion about the interpretation of geomorphology content and maps through the facilitation of educational specialists. Geography teachers should be better trained in geomorphology and map interpretation to prepare them to teach it. The teachers should be equipped with geomorphology content, as most teachers seem unprepared to teach geomorphology and map work simultaneously. This was also revealed by in *National Senior Certificate Diagnostic Report*. Therefore, teachers should always be trained on the content and the application of maps to meet the requirements of the teaching and learning of geography.

Synergy among Expert-teachers in the Geography Field

Geography teachers need to agree on the assistance and strategies that they need for the teaching of geomorphology and map work. Additionally, internal workshops for each district, facilitated by professors and field experts in geography, should be held to contribute to the theory and practice of the teaching and learning of geography.

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Authors' Contributions

KM wrote the abstract, introduction and background, research questions, and literature review. KSM wrote the theoretical framework, methodology, conclusion, and recommendations. JTM wrote the discussion of the findings.

Notes

i. This article is based on the doctoral thesis of Karabo Molapo.

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