Jurnal Pendidikan Teknologi dan Kejuruan
Vol. 31, No. 2, October 2025, pp. 130-146
https://journal.uny.ac.id/index.php/jptk/issue/view/77379
DOI: https://doi.org/10.21831/jptk.v28i1.77379

Fostering The Use Of Indigenous Knowledge System To Teach Freehand Sketches In Engineering Graphics and Design

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ABSTRACT

Teacher's expertise in design plays an important role in communicating drawing messages. This expertise is often influenced by their general knowledge and culture's identity and core principles, which is all part of Indigenous Knowledge. The purpose of this study was to explore teachers experiences in the use of Indigenous Knowledge System (IKS) to teach freehand sketches in engineering graphics and design. This study used a qualitative research approach and phenomenological design to understand participants experiences. Purposive sampling was used to select five teachers and a total of seventy-three learners. Indigenous knowledge framework was employed to capture all relevant information. Interviews and classroom observations were used to collect data and thematic analysis was used to analyse it. So, this study discovered that teachers used drawing designs inspired by South African cultural designs taken from Indigenous Ndebele decoration patterns, and Contextualised storytelling to foster Indigenous Knowledge when teaching freehand sketches in engineering graphics and design. As a recommendation, this study is still calling for a content knowledge structure that revolves around the application of IKS, rather than focusing just on a small number of topics where teachers must find creative ways to incorporate IKS.

Keywords: Indigenous Knowledge System, Freehand, sketches, graphics, engineering

Article history

Received:	*Revised:*	*Accepted:*	*Published:*
29 November 2024	*07 July 2025*	*25 August 2025*	*02 October 2025*

Citation (APA Style): Blose, P., & Mtshali, T. I. (2025). Fostering the use of Indigenous Knowledge System to teach freehand sketches in engineering graphics and design. Jurnal Pendidikan Teknologi Dan Kejuruan, 31(2). https://doi.org/10.21831/jptk.v31i2.77379

INTRODUCTION

Engineering graphics and design is a subject in the Further Education and Training (FET) band which builds on Technology as a subject of the General Education and Training (GET) band. Engineering graphics and design as a subject allows learners to communicate ideas graphically by using drawing instruments and computer-based tools (Mlambo, 2024; Zwane et al., 2021). One of the greatest advantages in engineering drawings is that it is not necessarily based on written words; all communication channels are narrowed to a drawing. Teacher's expertise in design plays an important role in communicating drawing messages. Freehand sketches thus provide a designer a chance to develop a skill to visually communicate concepts much quicker using a pencil and a paper (Springer,

2023). Ofcourse, creativity plays a big part of freehand sketching as a designer engages with brainstorming and expand on the draft drawings (Kamel & Khalil, 2023). In design subjects, it is expected that each learner engages with engineering drawings where most of them comes from mechanical and civil engineering (Sibiya et al., 2023). How then does this translates to indigenous design in a South African perspective?

Mapara (2022) argued that indigenous practices can be brought on board to indigenize the higher education curriculum in particular for the Agriculture and Sustainable Livelihoods programmes. Similarly, we argue that Indigenous practices can be used to indigenise the teaching of freehand sketches. For instance, Indigenous design represents a single culture's identity and core principles. It provides a significant representation of indigenous creative knowledge in society (Tunstall, 2020). Since indigenous designs are ingrained in a community's customs, connections, and practices, creativity serves as the fundamental foundation for design. According to Nkosi, Kola and Mtshali (2023) creativity is broadly viewed as a desired attribute for the quality of thinking that lays a foundation for innovation and change. It is also known as a process of becoming sensitive to a problem, deficiencies, gaps in knowledge, missing elements and disharmonies. Consequently, it is expected that teachers close their societal knowledge gaps through innovative designs and teach learners freehand sketches that resonate with what is indigenously valuable to them.

According to Gumbo (2016), indigenous technologies have historically been marginalized in education due to colonization, Since the conquering of indigenous people, African philosophy has not been included in the South African curriculum, (Ramose, 2004). Pophiwa and Saidi (2022) have also observed that the extant literature does not make any specific mention of Indigenous Knowledge Systems. This study has identified this pattern, which is consistent with prior research showing that Indigenous knowledge systems are still not adequately supported in engineering graphics and design. One recent study, conducted by Mtshali (2023), examined the mastery of content representation (CoRe) by engineering graphics and design teachers in the context of teaching civil drawing. According to the study's findings, educators could not view civil drawings as a way to advance equity and inclusion. This therefore leaves room for the inclusion of indigenous knowledge in freehand sketches in engineering graphics and design. Moreover, several studies such as those of Maeko and Khoza (2018); Żychowska

(2021); Zwane, Simelane-Mnisi and Skosana (2021) conducted on engineering graphics and design lack the aspect of Indigenous knowledge systems integration. Conversely, in their study, Blose and Gumbo (2019), revealed a lack of full advantage of Indigenous graphics knowledge and skills in teaching graphic designs. Singh-Pillay and Sotsaka (2020) saw a similar pattern and identified several elements that improved the spatial vision of female students. Among those characteristics, they mentioned that working with Indigenous patterns was realized to be helpful in enhancing student spatial visualization. However, spatial visualization was given more of the attention. Therefore, the purpose of this study was to investigate how teachers used Indigenous Knowledge Systems to instruct students in freehand sketching for engineering graphics and design.

Our statement is that any technical drawing should, in some way, represent the solutions that indigenous beings require. In this approach, the designs will foster the development of indigenous knowledge system within the drawing creative space. Inherent in the skill set of freehand design ought to be an understanding of the interplay among individuals' values, attitudes, technology, society, and surroundings. As per Gumbo's (2015) findings, technology teaching and learning activities, especially those involving engineering graphic design, should take into account a more equitable technological viewpoint along with creativity and cultural aspects. Fortunately, research conducted in 2024 by Blose and Gumbo established the groundwork for designing drawings that balance creativity and traditional knowledge. The way educators employ Indigenous Knowledge is all that remains– a knowledge gap that this current study sought to fill. Hence this study was guided by the following research question:

RQ: How do teachers use Indigenous Knowledge System to teach freehand sketches in engineering graphics and design?

LITERATURE REVIEW

Freehand sketches of engineering graphics and design

A free hand sketch is a hand-drawn illustration intended to provide details about a specific area or segment of a component or mechanism. It aids in eliminating errors on the drawings later on by having a clear understanding about the details that must be drawn (Mtshal, 2023). It also emphasises the basic hand movements needed to draw proportional single, Multiview and pictorial drawings on plain paper and/or grid sheets (Peters, 2020).

Freehand sketches given to learners in schools are normally from mechanical and civil engineering disciplines. This is because more than 70% of engineering graphics and design content comes from those two engineering disciplines. Electrical engineering component normally comes as part of civil drawings where learners are expected to draw electric features in the floor plan, see the example below.

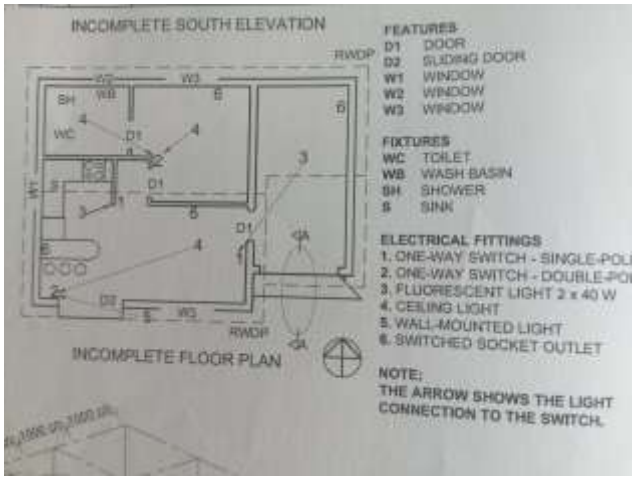

Figure 1: Floor plan

Ofcourse, design comes in different forms, such as graphic design, industrial design and built environment design (architecture, landscape architecture and interior design). Design skills can be acquired through simple drawings, such as two-dimensional (2D) and complex three-dimensional (3D) shapes (Sütçü, 2021). Henceforth, freehand sketches can follow the same dimensional pattern.

Fostering indigenous knowledge in design classrooms

According to Makgato and Khoza (2016) learners lack an understanding of graphics and its principles. Blose and Gumbo (2024) avers that this is caused by teachers switching off learners from their indigenous environments in the learning situation as their home/local knowledge is not being catered for. In fact, learners from the non-indigenous environments are also disadvantaged from learning about alternative knowledge forms and ways of technology. We must remember that aim of design subject is to introduce learners to the world of engineers, and how they apply their skills to solving problems graphically (DBE 2011). However, in absence of indigenous relevance in the knowledge, such aim of the subject may not necessarily be realised.

Lack of attention to the inclusion of IKS issues in design subject may threaten the actualisation of the subject and sketching. Reflecting on Jones (1997) assertion that brings another aspect of the design subject curriculum to the fore, one that gives the impression that, all too often, we simply have considered the impact of technology on society, rather than considered the different views people have about design; and the way these impressions are influenced by their beliefs, values and ethics. These different views people have about technological design should be applicable when dealing with Engineering Graphics and Design along with IKS. In spite of the findings of Makgato & Khoza (2016) and Chedi (2015), it seems that no effort has been made to integrate IKS into the curriculum, thus, learners still face challenges with the integration of IKS when learning graphic design.

A typical example of indigenous graphic design is the design by Esther Mahlangu (De Jager & Loots, 2003). Esther Mahlangu is a South African artist from the Ndebele tribe in Mpumalanga Province. She is known for her bold large-scale contemporary paintings that reference her Ndebele heritage. She is recognised worldwide because of her artwork. Her artwork thrives on indigenous knowledge. Her artwork is hailed worldwide. Her work draws from the integration of different disciplinary knowledge, such as mathematics, design and technology, history and the arts. From the design subject point of view, the artwork portrays the creative skills in the drawing or graphic work that resonates well with the Ndebele culture, which is the indigenous knowledge aspect. She uses basic resources, such as chicken feathers and sticks, as her paint brushes. The design and paintings show the aesthetic aspect of design and has a particular meaning in the Ndebele culture. The aesthetic aspect of design is so important because it makes the designed product appealing in terms of the colour, shape and patterns. This suggests that, when teachers engage learners to do graphic design work, indigenous aspects should be taken into consideration. Indigenous experts like her could always be modelled as anchors of freehand graphics philosophers.

CONCEPTUAL FRAMEWORK

Indigenous knowledge as a framework

To understand the use of Indigenous Knowledge Systems in teaching freehand sketches of engineering graphics and design, this study employed Indigenous knowledge as its framework. According to Maurial (1999) indigenous knowledge is the peoples' cognitive

and wise legacy as a result of their interaction with nature in a common territory. A version by Hart (2010) defines indigenous knowledge as the established knowledge of indigenous people, their worldviews and the customs and traditions that direct them. The two definitions are lacking in detail, as they are more of western orientation, which is not bad. However, there are a number of definitions of indigenous knowledge by various African scholars, such as Odora Hoppers, Gumbo, Shava and many others. Shava (2013) portrays IKS as a context rich knowledge that incorporates key important aspects, such as people, context, culture, language, knowledge, practices and dynamism.

Scholars such as Hoppers (2021) and Gumbo (2017) summarily associates IKS with traditional environmental knowledge that should be seen as a means to understand complex systems in order to give rise to a greater understanding of IKS. As mentioned earlier, IKS resonate with the aspects of people, context, culture, language, knowledge, practices and dynamism which is at the heart of the indigenous paradigm (Kigozi et al., 2021). Hence, in order to understand how teachers' experiences in the use of IKS to teach freehand sketching, this framework was viewed relevant in that teachers are to draw from their societal and traditional livelihood. The incorporation of social factors, such as the arts and indigenous symbols, towards drawing in the teaching of sketching may provide clarity, direction and focus to learners when they are given an opportunity to experience knowledge construction in graphic design and to express their design ideas through graphics as informed by their context-based designs.

METHOD

Research paradigm

In a pragmatic research paradigm, this study explored the use of Indigenous Knowledge Systems in teaching freehand sketches of engineering graphics and design. According to Borges and Revez (2019) a pragmatic research paradigm is a method that is based on empirical and experimental thought that applies to experience. As a result, this paradigm was found to be relevant as it assisted this study to understand experiences of teachers when dealing with freehand sketch designs. Research approach, designs and data collection procedurues are unpacked hereunder.

Research approach

In this study, a qualitative research approach was deemed adequate to gather comprehensive descriptive data and understand the subject being investigated (Merriam & Grenier, 2019). This qualitative approach further enabled the researchers to explore diverse perspectives within an engineering graphics and design teaching community regarding indiginoues knowledge systems.

Research Design

A phenomenological study design was considered to understand participants experiences. According to Casey (2000) include methodical phases in the data analysis processes, such as selecting a phenomena to investigate, conducting participant interviews, emphasizing recurring themes, and publishing work. This study was thus hinged into the phenomenological framework.

Sampling

Purposive sampling was used to identify five Technology teachers and seventy-three learners. The inclusion criteria were that the participants should be located in the Ndebele region in Mpumalanga province where the language is spoken as a home language. Another inclusion criteria was that the school teachers should be known for their appreciation of their culture so that it reflects into their practice. All other schools in the region which did not fall under the criteria were excluded in the phenomenon.

Data collection and analysis

Data was collected through interviews and classroom observations. According Mayring 2014) interviews are methods that relies on asking questions in order to collect data, this study asked teachers questions to collect relevant data. Interviews were recorded through a cellular phone and took about ten minutes for each participant. Both authors listened to the conversations and analysed them to select the most appropriate responses to this study. For observations, this study followed O'Leary (2020) guide by recording what occurs in the classrooms by systematically observing and keeping records of classroom events. Data was thematically analysed through a systematic process of identifying recurring themes, interpreting and explaining them, and drawing conclusions. This study subsequently collected, transcribed, verified, collated, coded and categorised the findings

(Clark & Braun, 2013). The trustworthiness of the study was ensured through the use of more than one data collection strategy from all the participants.

Ethical clearance

The ethical clearance approval (2019/02/13/56712715/17/MC) was granted by the institution affiliated with the leading author. This was to ensure that the study is conducted within acceptable research conducts.

FINDINGS AND DISCUSSION

To determine technology teachers' **use of Indigenous Knowledge Systems in teaching freehand sketches of engineering graphics and design,** this study used interviews and classroom observations to gather relevant data. So, this study discovered that teachers used drawing designs inspired by South African cultural designs taken from:

- Indigenous Ndebele decoration patterns, and
- Contextualised story telling

The foretasted themes are unpacked below.

Indigenous Ndebele decoration patterns to teach mechanical systems concepts

One of the most common fantasies of young people is their general love of cars. Sometimes they use the popular car brands they observe as inspiration to draw their favourite vehicles. As it can be seen in the figure below this segmement, the drawing teachers used designs from indigenous Ndebele drawings such as this one (figure 2) to inspire and enact their learners drawing techniques. It came as a surprise that that teachers could use this design to enact learners drawing creative abilities. The most interesting part was that they used a female indigenous designer for a product most liked by males. This was an interesting creative approach to teach learners how to draw sketches. Taneri and Dogan (2021) agree with the teachers' approach in that design learning expands on learners' prior implicit knowledge by creating tasks that aid in the implicit construction of a body of procedural knowledge. It also seeks to transform procedural knowledge into declarative knowledge through the use of panel critics, see the extract below.

Figure 2: Ndebele car design

Source: Mbali Kgame (2016) design indaba.

The above figure depicts the world-renowned Ndebele artist and educator Esther Mahlangu's BMW second release. Teachers used this examples as most students in Mpumalanga region know about Ndebele culture and regard it as the most indigenous designs. So, teachers had tasked learners to draw freehand sketches ranging from cars, aeroplane, bicycles and etc. So, the following figure shows what another learner drew.

Figure 3: A learner car drawing.

Although this figure shows a car brand that a learner drew, the teacher explained that

"the idea is to teach learners to use their prior knowledge and skills to draw so that our role becones to show them how to adequately use a freehand drawing technique" – interview response.

According to Mtshal (2023) one of the basic freehand sketches technique is that each time a learner draws, the pencil goes once in one direction and no back and forth. To understand this better, Mtshali (2023) states that freehand engineering drawings do not have lingering shadow lines in a line as it is done mostly in artwork. So, based on figure 2 above, learners applied acceptable freehand sketching technique. Enshrined in the engineering graphics and design curriculum, is the need to apply context in the knowledge and skill acquired. Ndlovu and Gumbo (2024) foot stamps the idea of using Indigenous knowledge to preserve society's norms and conventions into tackling societal and contextualised technological problems. Just like the car designed in isiNdebele culture, learners get to appreciate the need to understand where they come and how they can use their value systems to cope with the contemporary world.

Contextualised story telling

One of the thriving strategies to teach any child in South Africa is through story telling. They may come in a form of fairy tales or short stories. However, they are sure to teach someone how to cope with different situations. For example, choosing the appropriate narrative to tell at the right moment is a crucial educational skill in the classroom (Bowman, 2018). The telling of stories speaks to the meaning-seeking nature of humanity. Non-stories provide knowledge in a variety of educational contexts, but powerful narratives engage learners on an intellectual and emotional level, inspiring and motivating learning. The greatest advantage about them is that they increase learner imagination. Mlambo (2024) stresses the need to increase learner spatial abilities whenever drawings are involved. Evidently, in one of the teacher's interview responses said

> *"In drawing, a learner should be able to visual how his or her drawing will look like when complete"* – Teacher interview

In essence, the teacher response aligns with Bartlett and Camba (2023) that the role of a graphical interpretation is that it should be actualized in completeness before it is enacted. Put simply means that learners should imagine a complete drawing first before he or she can draw it. So, teachers mentioned that they use examples of situations that most learners

are familia within order to enact their drawing design imaginations. For example, teacher C used the following figure captioned “KZN storm: Efforts under way to rebuild schools, clear debris in Tongaat”

Figure 4: Dilapidated school building.

Source: Sakhiseni Nxumalo (2024) News24.

Teacher C then tasked learners to come up with freehand sketches of classrooms that the government will need to build. When you look at how the task was structured, it promoted problem solving and spatial visualization skills. This are the leading goals of Technology subject in schools. Furthermore, Blose and Gumbo (2024) along with Ndwandwe et al. (2024) reminds us that one of the characters of indigenous knowledge systems is that is based on local context and lived experiences. Engineering Graphics and Design makes learners aware of the importance of being culturally and aesthetically sensitive across a range of social contexts, participating as responsible citizens in the life of local, national and global communities. Thusly, teachers were able to use such stories as tasks to infuse indigenous knowledge in their instruction.

CONCLUSION AND RECOMMENDATION

For the longest of times, teaching Technology concepts in South African schools have been categorised as extremely Eurocentric and disregarding the knowledge of communities in which this Technology subject is taught. So, in light of the above findings, this study discovered that there were attempts that teachers were forging to ensure that indigenous knowledge systems strive in the Technology curriculum. While this is commendable, this study is still calling for content knowledge structure that is centred around the use of IKS and not just selected few content where teachers need to crack head

to think about how to integrate IKS. This study was limited to Mpumalanga province of South Africa where Ndebele culture is practiced. It is hoped that studies that focuses on cultures such as Sesotho, isiZulu, Venda and etcetera would emerge and chant a global discourse on how to better equip teachers to integrate IKS with Technology concepts.

ACKNOWLEDGMENT

Special thanks to all the participants who participated during the data collection process.

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