Exploring rural and urban disparities in primary school learners' perceptions of scientists

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Abstract
The study explored the perceptions of scientists and their roles by Namibian learners from rural and urban primary schools in Ompundja circuit, Oshana region. The Draw-a-Scientist-Test (DAST) was used to investigate the ideas of 176 learners aged 9 to 11 years. Stratified, random sampling was utilised to select the learners, and the resulting quantitative data were analysed using descriptive statistics to investigate the perceptions. The study revealed the rural-urban divide in science education experiences or exposure from the drawings. A notable finding was the low prevalence of the traditional scientific dress, the laboratory coat, especially from rural schools. This could be due to limited exposure to the stereotypical image of scientists. Drawings by learners in rural schools had a higher number of nature elements such as plants. This indicated a nature-centric view and experiences of science. Mathematics and science teachers featured quite prominently in rural learners' illustrations, suggesting the crucial role they play in shaping learners' perceptions. Rural learners' drawings had fewer descriptive elements compared to urban learners and this point to a potential gap in the communication abilities or the ability to express scientific knowledge. Vocational trades featured in drawings especially from rural schools hinting at a broader understanding of science beyond the stereotypical laboratory setting. The results from this study emphasised the importance of context-specific strategies and educational practices that cater for the diverse experiences and localities of learners, particularly in rural environments. Conclusively DAST opens the importance of the role of place in shaping educational experiences of learners and recommends the need for educational practices that cater to diverse experiences and contexts and to create learning networks rooted in place.

Keywords: *draw-a-scientist-test, perceptions, scientists, primary school learners, laboratory, knowledge*

Background

The then the Ministry of Education, Arts and Culture (MoEAC) in Namibia introduced the revised National Curriculum for Basic Education (NCBE) which was rolled out and implemented from 2015 to 2018. The curriculum has several key objectives aimed at directly addressing the Sustainable Development Goal 4 (SDG4) that focuses on equitable quality education for all (MoEAC, 2017). The revised curriculum addresses the previous curriculum's shortcomings by better equipping learners with the skills and knowledge that they need to succeed in the Namibian society (MoEAC, 2023). The Senior Primary school phase was adjusted to start from Grade 4 (lasting four years) as opposed to the previous phase that started from Grade 5 to 7 (lasting three years). The early exposure of learners to science and the lengthening of the phase from three to four years, is envisaged to afford teachers ample time to build learners' scientific literacy. Through this, teachers can shape how learners view science and the people involved in science, that is, scientists. The overarching aim of teaching science to young learners is to ignite the passion in the field "with the hope of producing the much-needed scientists for the country" (MoEAC, 2023, p. 1).

In resonance to the revised curriculum, Goos et al. (2020) pointed out that perceptions of scientists are essential to ignite passion for science in young learners and inspire them to become scientists. Similarly, Badri et al. (2016) stated that learners' images of science and scientists as well as the way science is taught, influence learners' career choice. To bring forth the perceptions of science and scientists held by learners, the Draw-A-Scientist Test (DAST) was employed. The DAST was developed by Chambers in 1983, and it has been used for decades to examine and evaluate learners' perceptions (Finson, 2003). Finson et al. (1995) developed a checklist used in conjunction with the DAST to strengthen its objectivity and reliability. The Draw-A-Scientist Test Checklist (DAST-C) makes it possible to quantify scores from drawings and can be used for comparative data analysis. Learners' drawings offer insights into their cognitive schemas, feelings and thoughts about the world (D'Addezio & Besker, 2024; Thomson et al., 2019). In the DAST-C, the participants are given a simple request to draw a picture of a scientist at work. Even though it's a simple drawing task, its strength lies in its non-verbal nature, thus making it accessible to a wide range of participants. This study therefore employed the DAST-C to unearth primary school learners' perceptions of scientist and the work they do.

Research questions

The study sought to answer the following research questions:

1. What are primary school learners' perceptions of scientists and what scientists do?
2. What are the differences between urban and rural school learners' perceptions of scientists and their roles?
3. How does learners' location (urban or rural) influence their perceptions of scientists and science?

Through an examination of these research questions, this study investigated grade four learners' perceptions of scientists and their work, with particular attention to the influence of the school geographical context on these perceptions and the implications for educational practice.

Limitations

First, the study had a narrow age range of 9 to 11 years, covering only grade four learners. Widening the age range could provide more comprehensive results, as perceptions of scientists may evolve as learners progress through their education journey. Second, the research was conducted in one education circuit in the Oshana region with homogenous socio-cultural circumstances. Learners' perceptions might be influenced by socio-cultural circumstances; thus, including participants from different geographical backgrounds could broaden understanding and allow for generalisability of the findings in the broader Namibia. Third, the targeted sample size was 200; however, 24 learners withdrew, culminating in a sample size of 176. This reduction in sample size may have affected the statistical power of the analyses and the ability to detect smaller but meaningful differences between groups. A larger sample size could yield more statistically significant results. Fourth, the overall gender representation in the sample was nearly balanced, with 43.75% girls and 56.25% boys, and this slight imbalance occurred within each location (more boys in rural schools and balanced representation in urban schools). A balanced gender representation could strengthen the findings regarding gender issues. Finally, the data collection was based on drawings, and this may be influenced by the artistic abilities of the learners. All the limitations may restrict the generalisability of the findings.

Literature review

The Draw-a-Scientist Test Checklist (DAST-C) has been widely used across diverse educational contexts to examine learners' perceptions of scientists and their work (Archer et al., 2015; Brumovska et al., 2022; Chionas & Emvalotis, 2021; Emvalotis & Koutsianou, 2018; Leavy, 2023; Wong, 2015). The most common stereotypes are white/Caucasian, older males working in a laboratory surrounded by complex equipment (Samaras et al., 2012) and in cases where females are depicted, they are portrayed as "superwomen", that is, exceptional women (Flicker, 2003 in Thomson et al., 2019). Moote et al. (2019) state that by the age of 10, gendered differences are evident in science-related career choices.

The racialised and gendered portrayals may alienate learners, especially girls and learners from ethnicities other than white/Caucasian, from seeing themselves as scientists (Hilte, 2021; Kelly, 2018; Finson et al., 2018; Finson, 2010; Wong, 2015; Zhai et al., 2013). Therefore, learners may view science as separate from their daily lives, hampering their potential pursuit of a scientific career. Moreover, associating science professions with "genius" or "brilliance" may discourage learners from pursuing such careers, and girls are particularly affected by such connotations (Bian et al., 2017; Leslie et al., 2015). McCann and Marek (2016) suggest that socio-economic background may also influence learners' perceptions. Those from high-economic backgrounds tend to draw scientists as white and male, while those from low socio-economic backgrounds draw less stereotypical scientists. Learners from developing countries depict scientists as helping people and have less stereotypical views of scientists in comparison to those in developed countries (Thomson et al., 2019). The main factors contributing to these stereotypes are portrayal of scientists in media and in learners' science literature as well as limited real-world exposure to scientists and science (Özel, 2012). Media rarely reflect the diversity of scientists, and if learners do not see scientists that look like them or come from similar backgrounds, they might be averse to pursue careers in science. Christidou et al. (2019) analysed Greek scientists' depictions in media and found that male scientists in laboratory coats were very prominent; however, there is an evolution from practical hands-on aspects of science to theoretical aspects of scientific inquiry. The drawback is that the contemporary images lack context and social interaction, making science appear as a solitary pursuit which may discourage interest in science careers.

Kelly (2018) noted that learners' science literature often lacked diversity in the types of scientific fields covered with most books focusing on life science, principally animals. Hilte (2021) also noted the prevalence of Biology-related careers in science literature, and this led to a nature-centric view of science. Exposure to a range of scientific disciplines opens the vastness of the scientific world, delimiting science to plants and animals leading to learners exploring various career paths and the realisation that science disciplines interact and build upon each other. D'Addezio and Besker (2024) investigated how the perceptions of primary school learners changed over a decade (2011-2021). Their study revealed shifting gender representation, thus, although the dominant image of scientists remained mostly male, there's a significant increase in girls drawing female scientists. Additionally, the scientific focus shifted towards environmental and health-related themes. This can be ascribed to media shifting focus to socio-scientific issues such as global warming, climate change and pandemics.

From the literature review, one study by Thomson et al. (2019) contrasted rural and urban learners' perceptions of scientists using DAST-C. Most of the research was limited to urban locales; moreover, the one that was conducted in a rural setup was conducted in a developed country. Further, there is very limited research about the role of *place* and how it shapes education experiences of learners. Therefore, this study, conducted in a developing country, aimed to explore and compare rural and urban learners' perceptions of scientists and what scientists do using DAST-C as well as reveal the importance of *place* as more than biophysical space, but rather as a potentiality that compels actors to engage with, create and use a locale to encourage diversity of learning.

Theoretical framework

This research was grounded in the constructivist theoretical framework that theorises that humans actively construct knowledge through the interplay of prior learning and newer learning (Martin et al., 2005). Knowledge construction does not only happen when an individual constructs their own knowledge and understanding based on existing ideas, but also through socio-cultural interactions in which they engage in (Eastwell, 2002). Knowledge develops in two fundamentally different ways, that is, through personal experience (spontaneous concepts) and through formal instruction (scientific concepts) (Cakir, 2008). Spontaneous concepts are rooted in a learners' everyday life, are often practical and may lack systematic organisation.

Scientific concepts are introduced deliberately in educational settings and are systematic and organised. Constructivism posits that these two concepts interact and influence each other, thus, learning occurs through a dynamic interplay of personal, social, behavioural and environmental factors. In the context of DAST, these factors shape children's understanding of scientists and their work and the DAST serves as a tool to reveal their perceptions. Moreover, the act of drawing itself is an active process of constructing and presenting their understanding. The constructivist framework acknowledges that each child's drawing is a unique representation of their individual construction of what a scientist is.

Methodology

The study employed a quantitative research approach through descriptive statistics to analyse learners' perceptions of scientists and their work. The Draw a scientist Test Checklist (DAST-C) was used to investigate 176 learners' perceptions. The DAST-C was chosen for its effectiveness in revealing unprompted ideas about scientists and their work.

Research setting

The research was conducted in six public primary schools, three located in rural and three in urban areas of the Oshana region, Ompundja education circuit, Namibia. The study area is shown in Figure 1.

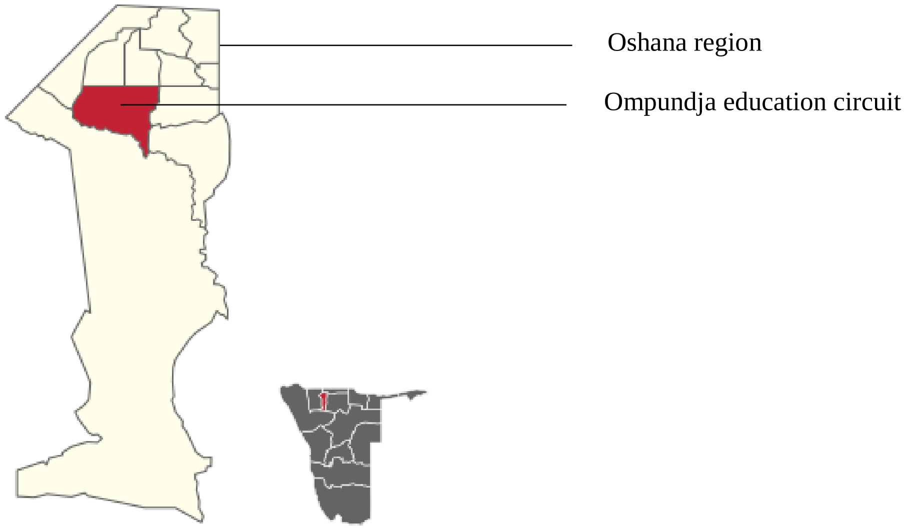

Figure 1: Study location (source: https://oshanarc.gov.na/Ompundja)

The area is largely rural with one urban centre with a total of 26 public schools. From this, four were secondary schools, one was a special school, one offered only grades 0 to 6 and seven were exclusively Junior Primary schools. Thirteen (13) schools housed the Senior Primary grades 4 to 7. Seven of the 13 primary schools in the circuit were rural leaving six urban primary schools.

Study population and sample

To achieve a representative sample across rural and urban locations, purposive, stratified random sampling techniques were used on a population of 21 schools offering grade 0-9 in Ompudja education circuit. Thirteen (13) primary schools offering Senior Primary phase (grades 4 to 7) were identified through purposive sampling. These schools were then divided into two strata: rural and urban. This resulted in the rural stratum consisting of seven schools and six schools in the urban stratum. To select three schools from each stratum, simple random sampling was used. The names of all schools within each stratum were written on separate slips of paper. A simple random draw, without replacement was conducted for each stratum, resulting in a total of six schools, that is, three rural and three urban.

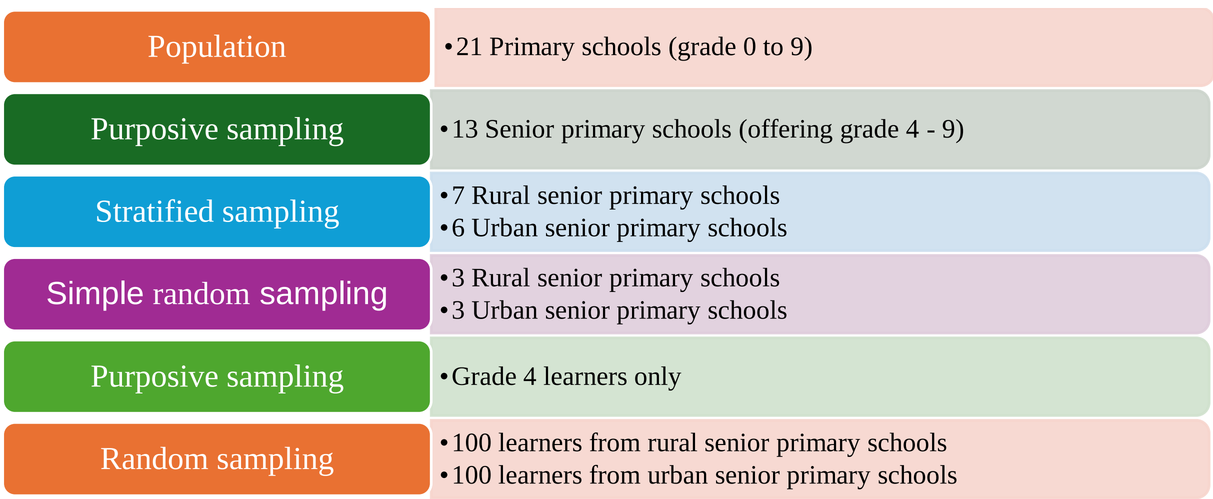

Figure 2: Sampling strategy

The study focused on learners in Grade 4 only, as this is the initial grade in the senior primary phase and the first exposure to natural science content. All Grade 4 learners from the selected schools comprised of a population of n = 408. A purposive sample size of 200 participants was targeted, with equal representation from both rural and urban schools (100 learners from each location). To achieve this, the names of all Grade 4 learners from the selected schools were written on slips of paper. A random draw was then conducted to select the final sample of 200 participants. Of the 200 participants, only 176 ultimately took part in the research and 24 could not participate due to absenteeism or non-response.

Data collection and DAST-C implementation

Each child received a standardised set of materials, that is, one A4 sheet of plain white paper, a pencil and an eraser. Instructions were given in both the local vernacular and English language to ensure that all participants understood the task. Demographic information such as age, gender, grade and location (rural or urban) were gathered. Learners were encouraged to imagine a scientist at work and then to draw what they imagined. They were also given an option to add sentences in their preferred language to explain the scientist's activities in their drawings. It took about 30 minutes to complete the task.

Data analyses

The drawings were collected on the same day and analysed by looking for the following seven indicators developed by Finson et al. (1995), that is:

1. Symbols of research (equipment associated with scientists and science e.g. microscopes, glassware, etc.)
2. Symbols of knowledge (e.g. books, pens in pockets, etc.)
3. Attire (laboratory coat, eyeglasses)
4. Technology (the products of science e.g. laptops, robots, phones. etc.)
5. Gender (presence of beard, moustache)
6. Relevant captions (formulae, taxonomic classification, the "eureka" syndrome, etc.)
7. Relevant description/sentence added to describe the activities of a scientist

Each drawing was analysed to determine the frequency of the DAST-C indicators in the drawings. The race indicator from DAST-C was omitted because the drawings provided insufficient information on the race of the scientist.

Results

Demographic information

The mean age of participants was 10 years. The girls were 77 (43.75%) and the boys were 99 (56.25%). The geographical distribution was as follows: rural schools had 39 (39.0%) girls and 61 (61.0%) boys; urban schools had 38 (50%) girls and 38 (50%) boys. The total number of participants was 176.

Learners' perceptions of scientists

Drawing and annotations collected were analysed to address the research questions. The first question sought to expose learners' perceptions of scientists and their work. Table 1 presents a breakdown of the indicators that emanated from the data.

Table 1: Learners' views of scientists (n = 176)

Indicator	**Number of learners (rural + urban)** n = 176 (%)
Symbols of research	35 (19.9)
Symbols of knowledge	13 (7.4)
Attire	12 (6.8)
Technology	23 (13.1)
Gender (presence of beard, moustache)	118 (67.0)
Relevant captions	8 (4.5)
Relevant description added	89 (50.6)
No indicators observed aside from gender	30 (17)

Table 1 shows the number with the associated percentage of the learner's perception of a scientist. The incorporation of symbols associated with research was observed in nearly one-fifth (19.9%) of drawings from participants. Among the research symbols, the dominants were the test tubes, beakers, and flasks. Symbols of knowledge (7.4%) and attire (6.8%) were less prominently displayed in drawings. Technology appeared in 13.1% of the drawings and a small percentage (4.5%) of the learners included relevant captions in their drawings. However, just over half (50.6%) added relevant descriptions. Male scientists were drawn in 67.0% drawings. A small number of drawings (17%) lacked any of the indicators aside from gender.

Geographical variations: Rural vs urban depictions of scientists

The second research question aimed at exploring potential geographic variations by comparing drawings from rural and urban schools. Key differences were observed as set out in Table 2.

Table 2: Geographical differences (n = 176)

Indicator	**Rural learners** n = 100 (%)	**Urban learners** n = 76 (%)
Symbols of research	9 (9.0)	26 (34.2)
Symbols of knowledge	9 (9.0)	4 (5.3)
Attire	1 (1.0)	11 (14.5)
Technology	12 (12.0)	11 (14.5)
Gender (presence of beard, moustache)	74 (74.0)	44 (57.9)
Relevant captions	0 (0.0)	8 (10.5)
Relevant description added	20 (20.0)	69 (90.8)
No indicators observed aside from gender	25 (25)	5 (6.6)

Table 2 depicts that learners from urban schools incorporated symbols of research, mainly glassware, in their drawings (34.2%) compared to only 9.0% by rural learners. Books were the main symbol of knowledge observed in 9.0% rural learners' drawings and in 5.3% urban learners' drawings. Technology appeared in 12.0% rural learners and 14.5% in urban learners' drawings. The most recognisable attire of scientists, the laboratory coat was mostly absent in rural learners' drawings. Only 1.0% of the rural learners drew the laboratory coat compared to 14.5% for urban learners. Scientists were depicted as male (the presence of beard or moustache) appeared in 74.0% of rural drawings and in 57.9% of urban drawings. A very significant portion (90.8%) of urban learners included relevant descriptions within their drawings compared to only 20.0% of rural learners. Additionally, urban learners (10.5%) added captions to explain their drawings, compared to none for rural learners. A significant number of drawings (25.0% rural and 6.6% urban) lacked six of the indicators except gender.

Girls' vs Boys' perceptions of scientists

While this study mainly focused on rural vs urban differences, the researchers were also interested in exploring potential gender differences in perceptions of scientists. Table 3 summarises these variations observed for each gender.

Table 3: Gender differences (n = 176)

Indicator	**Girls** n = 77 (%)	**Boys** n = 99 (%)
Symbols of research	14 (18.1)	21 (21.2)
Symbols of knowledge	9 (11.7)	4 (4.0)
Attire	3 (3.9)	9 (9.1)
Technology	15 (19.5)	8 (8.1)
Gender (male scientist)	19 (25.0)	99 (100)
Relevant captions	6 (7.8)	2 (2.0)
Relevant description added	40 (51.9)	49 (49.5)
No indicators drawn (apart from gender)	12 (15.6)	18 (18.1)

From table 3, symbols for research appeared more in boys' drawings (21.2%) compared to girls (18.1%). However, girls had a higher score for symbols of knowledge at 9.0% in comparison to boys at 4.0%. More boys (9.1%) drew scientists wearing a laboratory coat as opposed to 3.9 % of girls opting to do so. A noteworthy difference is the inclusion of technology in the girls' drawings at 19.5% compared to 8.15% for the boys. All the boys drew male scientists while 25.0% girls also drew male scientists. The inclusion of relevant captions appeared in only 2.0% boys' drawings while slightly more girls (7.8%) included such captions. Relevant descriptive elements appeared almost equal for both genders (girls 51.9%; boys 49.5%).

Learners' perceptions of scientists' work

The types of scientific activities engaged in by the scientists as indicated by the participants are outlined in
Table **4**.

Table 4: Categorisation of scientist roles as illustrated by participants (n = 176)

Activity	Overall n = 176 (%)
Science or math teacher	47 (26.7)
Conducting experiments (making potions, mixing chemicals)	30 (17.0)
Gardening (watering plants)	15 (8.5)
Medical personnel	14 (8.0)
Vocational trade (car mechanic, brick layer)	8 (4.5)

The data analysed in Table 4 show that the most prominent activity of scientists was that of science or mathematics teacher with 26.7% learners drawing them followed by scientists conducting experiments in 17.0% of drawings. Garden scenes were observed in 8.5% drawings, medical personnel in 8.0% drawings and vocational trades appearing in 4.5% illustrations.

Table 5 shows variations between rural and urban learners' depictions of scientific work engaged in.

Table 5: Variations between rural and urban scientific activity representation (n = 176)

Activity	Rural learners n = 100 (%)	Urban learners n = 76 (%)
Science or math teacher	31 (31.0)	16 (21.1)
Conducting experiments (mixing chemicals)	8 (8.0)	18 (23.7)
Gardening (watering plants)	9 (9.0)	6 (7.9)
Vocational trade (car mechanic, brick layer)	5 (5.0)	3 (3.9)
Medical personnel	8 (8.0)	6 (7.9)

More rural learners (9.0%) drew garden scenarios in comparison to 7.9% of urban learners. The same variation was observed where teachers appeared in 31.0% rural learners' drawings with 21.2% urban learners doing the same. More urban learners (23.7%) draw scientists conducting experiments compared to rural learners (8.0%) whereas medical personnel appeared equally in both rural (8.0%) and urban (7.9%) learners' illustrations.

Discussions

The study explored rural and urban primary school learners' perceptions of scientists and their work and examined how learners' location influences their perceptions of scientists and science as expressed through their drawings. Overall, the findings are in accordance with the studies of Hilte (2021) and Emvalotis and Koutsianou (2018) whose concurred in their findings that symbols of research (test tubes and other glassware) are more prevalent than symbols of knowledge (mainly books). This can be attributed to learners holding the stereotypical view of scientists as researchers or laboratory activities that does not go beyond research. A notable difference from results in this study was the absence of the stereotypical laboratory coat compared to other researchers such as D'Addezio and Besker (2024), Emvalitis and Koutsianou (2018), Hilte (2021), Samaras et al. (2012) and Thomson et al. (2019). This was more prominent in rural learners' drawings and might point to possible differences in educational experiences or exposure to scientific practices between urban and rural contexts (Hill et al., 2018).

Monhardt (2003) in Laubach et al. (2021) explained that when learners "had no conception of a scientist, their drawings contained fewer stereotypical images" (p. 1773) and may lack any of the indicators as observed in a significant portion of rural learners' drawings. Thus, learners perhaps relied on their own imaginations potentially resulting in a more personal interpretation of scientists and their work. Koren and Bar (2009) showed that culture and socio-economic status influence learners' perceptions. Those from ethnic minorities and lower socio-economic status drew less stereotypical images and this was attributed to inadequate school experiences with science. Interestingly, learners from private, wealthy schools also drew less stereotypical images; however, the reason for this is that they held more accurate and sophisticated perceptions (Buldu, 2007). This study mirrors previous findings about gender where persistent bias exists towards male scientists (Emvalotis & Koutsianou, 2018; Toma et al., 2022; Leavy et al., 2023), particularly in rural settings.

The influence of media, limited exposure to female scientists in media and books and the focus on male historical scientists could be reasons for this persistence. Primary school learners when asked to give names of historical scientists in a study by Pekmez (2018) only mentioned male scientists names such as Thomas Edison, Albert Einstein and Alexander Graham Bell. The gendered bias can be attributed to populating media with images of male scientists. Farland-Smith et al. (2017) found that images in books aid in understanding content presented. Images help learners develop a language of science, and gains in this understanding of language of science may extend to developing and acquiring the language of scientific inquiry such as observation, hypothesising and posing questions (Farland-Smith, 2017). Learners might then use science language competency to develop their identity as scientists in- and outside of the classroom and eventually a career. Good et al. (2010) in Hilte (2021) suggest that text containing female scientists improved female learners' comprehension of said text compared to reading the same text with stereotypical male imagery.

Inclusive images of scientists especially during formative years of adolescent development are important due to the power of images affecting learners' interest in a science career and it may carry on into adulthood (McCann & Marek, 2016; Myers, 2014). Negative stereotypes in media may generate stereotype threats, which in turn, shaped intellectual identities that might affect career aspirations. The language used in science stories when referring to females as "women scientists" whereas males are referred to merely as "scientists" implies that male is the default gender when it comes to science as a career. The necessitated gender qualifier term used to describe scientists as "women", carries connotation of the female scientist as an oddity. McCann and Marek (2016) observed that magazines and books, when reporting achievements of women scientists, describe them as "the first woman to win a Nobel prize in science is a scientist and a wife" whilst none of the male are described as "scientists and husbands" or "scientists and fathers". The underlying message is that it is unusual for a woman to be a scientist.

An analysis of written descriptions of the drawings showed scientists conducting experiments, often involving mixing chemicals, while observation and communication were rarely observed (Laubach et al., 2012). Learners confined scientists' workplace as indoors, such as the laboratory, greenhouses, museums and offices (D'Addezio & Besker, 2024; Rawson & McCool, 2014) and the field of specialisation was heavily biased towards natural sciences such as chemistry, physics and biology (Thomson et al., 2019; Emvalotis & Koutsianou, 2018; Pekmez, 2018, Samaras et al., 2012). Monhard (2003) highlighted the outdoor workplace, noting that remote learners often depicted scientists on farms, lakes, rivers, zoos, and mountains. Consistent with this, this study found that a higher percentage of rural learners (9%) included elements of nature, specifically gardening, in their drawings.

It is noteworthy that participants in this study exclusively drew plants and no animals as part of the outdoor, garden scene. Symbols of research or knowledge, or any equipment or activity associated with science were conspicuously absent; indeed, the only activity was watering plants. When comparing the garden scenes in drawings to those of teachers, it was observed that illustrations of teachers depicted them engaging with scientific content in contrast to garden scenes. This could be due to learners not viewing the school garden as an extension of their science classroom. This disconnect may stem from learners perceiving these spaces as separate from the science classroom. This fragmented experience may result in viewing gardens as mere biophysical spaces and not places that can be experienced and influenced by scientific and personal experiences that possess pedagogical importance (Gruenewald, 2003). Sánchez (2024) posits that the relationship between science and its production spaces has historically been problematic, particularly when media representations fail to acknowledge the specific locations where knowledge is created. This omission effectively transforms these production spaces into what Sánchez describes as 'placeless places' (literally places without place)' that neglect the influence of socio-economic and cultural factors. Scientific knowledge is produced in specific locations, utilising particular resources, and influenced by local conditions and this reveals the inherent connections between science and its social and cultural contexts. Human institutions such as schools, and on a smaller scale, science classrooms, may not demonstrate an orientation of care and consciousness towards the places they shape; therefore, the onus lies on science teachers to make education more meaningful by connecting it to the local context. One way of doing this is through Granit-Dgani's framework in Yemini et al. (2023) that serves as a tool to harness the power of place to enrich educational experiences of learners. The framework suggests four distinct, yet interconnected dimensions:

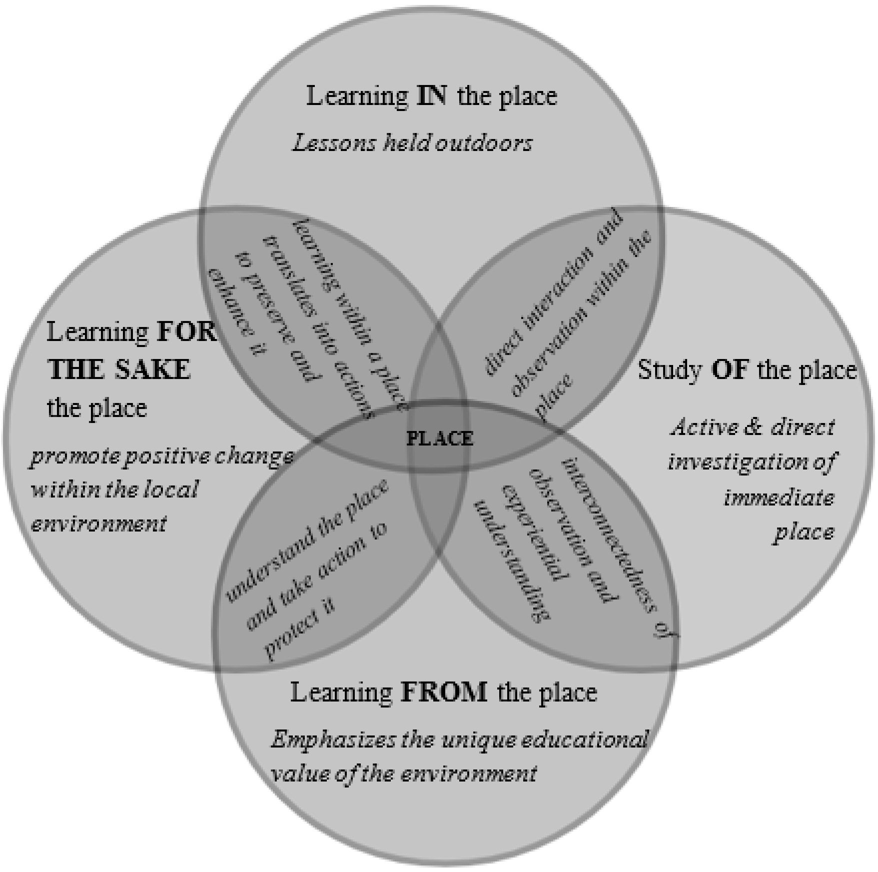

Figure 3: Adapted Place-Based Engagement Framework (Source: Authors)

Figure 3 guides teachers to move from 'learning in place' (that is, moving lessons outdoors) and 'study of the place' (learning about the environment) towards deeper engagement through 'learning from the place' (using the environment as a learning and teaching tool) and 'learning for the sake of place' (advocating for environmental change). This approach is crucial especially in resource-scares places that often, are rural areas. The term rural carries assumptions of these places as being backward, marginalised, under-resourced and under-developed. This devalues the potential of such places, a missed opportunity that could be addressed through place-based and place-conscious pedagogies, which leverage local characteristics to create vibrant learning spaces. Herman et al. (2022) demonstrated that contextualising education though place-based learning shifts learners' perceptions of science away from simplistic stereotypes towards a more realistic understanding of the work of scientists. Buldu (2006) found that teachers were portrayed as scientists, similar to what participants did in this study. This highlights the importance of school-level factors in the aspirations of learners (Moore et al., 2019) because teachers are viewed as accessible, relatable role models and play a prominent role in shaping learners' scientific aspirations, especially in rural schools, potentially due to limited exposure to a variety of scientific professions. Zhai et al. (2014) explored primary learners' images of doing science and how they compare themselves to real scientists. They found that images held by most learners are that of 'doing science as learning from the teacher' as well as 'doing science as conducting hands-on investigations' cementing the importance of science teachers and practical work.

As stated previously, mathematics and science teachers' illustrations included symbols of research and knowledge, science content and attire written or drawn on the chalkboard pointing to a strong association of teachers with science. To take advantage of this association, Dickson et al. (2021) suggest that teachers should transform their classrooms into places that actively engage learners in the practices of scientists such as asking insightful questions, especially those anchored in real-life problems that are familiar to learners and encourage learners to develop appropriate solutions through collaborations (Zhai et al., 2014). Similarly, Emvalotis and Koutsianou (2018) recognise that teachers are key in exposing learners to realistic conditions of production and reproduction of scientific knowledge allowing them to recognise and understand the nature of science and its usefulness in everyday life.

Farland-Smith et al. (2017) observed that school activities help learners develop their perceptions of what scientists do, therefore teachers need to plan learner-centred activities that afford them opportunities to explore their world and encourage them to think of themselves as scientists. This can potentially be realised through inquiry-based learning (IBL) as this teaching strategy enables learners to work like scientists especially when guided by the teacher. IBL and practical work have a positive impact on learners' science process skills, science concepts and content knowledge (Schiefer et al., 2017) and gives a deep understanding of the scientific process and the role of scientists both of which are essential for fostering a deeper understanding of the nature of science. Despite these benefits, Namibia's school science teachers display a limited repertoire of teaching strategies and therefore overly rely on traditional teaching methods such as lecturing which emphasise theoretical knowledge (Katukula, 2018). Shivolo and Mokiwa (2024) as well as Duarte et al. (2018) recognise the pedagogical inertia of Namibian primary school science teachers and ascribe the inertia to a confluence of factors such as limited resources, insufficient professional development opportunities for teachers, and entrenched instructional habits. Remoteness of rural schools and poorly resourced science classrooms create a double challenge for teachers and make it nearly impossible to obtain basic resources (Shikalepo, 2020; Zinger et al., 2020; Du Plessis, 2014). This hinders the use of diverse instructional strategies by teachers, restricting learners to lecture-based learning and limiting exposure to a variety of learning experiences.

Duarte et al. (2018) aptly captured it by stating that while the Namibian science curriculum is uniform, the conditions in schools and science classrooms are vastly different in terms of access to resources. All these issues collectively impede transition towards IBL and practical work, and the impedance is more pronounced in poorly resourced schools. Descriptive elements and captions were rarely added to drawings by participants. This can be ascribed to the fact that the grade in which participants of this study were is the first grade in which the medium of instruction changes from mother tongue to English instruction. For learners whose native language is not English, instructions in English are difficult to understand (Ferreira, 2011) and this language barrier is likely to have hindered their ability to not only communicate effectively, but also to grasp scientific content. Researchers such as Thomson et al. (2019 and Samaras et al. (2012) identified the type of activities associated with the work of scientists in learners' drawings ranging from medical practice (most frequent), engineering, agriculture, chemist, and car mechanic. This shows an understanding by learners of the multidimensional nature of science.

Participants in this study also depicted medical personnel as scientists and a small number of participants included vocational trades (car mechanic and brick layer) with their appropriate tools of trade in their illustrations suggesting that learners recognised the application of scientific principles in practical trades. Similar observations were made by D'Addezio and Besker (2024) where, in addition to health themes, environmental themes were incorporated into drawings. Thus, learners may be able to connect scientific principles to practical applications, and this calls for more engaging and relevant learning experiences.

Conclusion

This study offered insights into Namibian rural and urban primary school learners' views of scientists and their work. Differences in science education experiences between rural and urban schools were expressed in the following indicators: scientific attire, symbols of research and knowledge, technology, relevant captions and descriptions. In all these indicators, urban learners included them at a higher frequency. This shows that urban learners significantly understood the investigative nature of science, and that it involves intellectual exploration and knowledge acquisition. The low prevalence of the indicators in rural learners' drawings suggested limited exposure to scientific imagery. The inclusion of garden scenes by rural learners opens the possibility of utilising the school gardens as *places of science* where exploration, inquiry and investigations are conducted.

The prominence of teacher figures that they play a crucial role in shaping learners' perceptions by modelling consistent scientific behaviour and thinking. The inclusion of vocational trades by learners from both geographical locales suggested a broader understanding of science that extends beyond the traditional laboratory settings as well as recognition of the application of science in practical fields. The overall findings emphasised the importance of science experiences that went beyond textbooks and the science classroom and to give learners opportunities to develop a more diverse and sophisticated understanding of scientists and the work they do regardless of location.

Recommendations

These findings underscored the need for educational practices that cater to diverse experiences and contexts and to create learning nodes and networks rooted in *place.* This can be done by developing and implementing a curriculum that actively integrates school gardens into primary school science education and to train teachers to use the gardens as places for scientific inquiry, exploration and investigation. To achieve this, a multi-stakeholder approach is advocated. On a national level, the National Institute of Educational Development (NIED) as the curriculum development and research arm of the Ministry should revise the primary school science curriculum to integrate school gardens and inquiry-based learning.

Regional directorate should prioritise the trainings and support science teachers through workshops to equip them with practical skills and confidence to use garden spaces for science and model scientific inquiry.

The institutions of higher education should embed place-based and inquiry-based pedagogy into the core training of primary school teachers.

School management should afford teachers opportunities for continuous professional development and provide resources and timetable flexibility to utilise the gardens effectively.

Teachers with the support from the regional directorate and school management should adopt place-based strategies, design lessons to explore scientific principles and apply hands-on within their local contexts.

References

Archer, L., Dewitt, J., & Osborne, J. (2015). Is science for us? Black students' and parents' views of science and science careers. *Science Education, 99*(2), 199-237.

Bian, L., Leslie, S. J., & Cimpian, A. (2017). Gender stereotypes about intellectual ability emerge early and influence children's interests. *Science, 355*(6323), 389 - 391.

Brumovska, T., Carroll, S., Javornicky, M., & Grenon, M. (2022). Brainy, crazy, supernatural, clumsy and normal: Five profiles of children's stereotypical and non-stereotypical perceptions of scientists in the Draw-A-Scientist-Test. *Journal of Educational Research, 3*, 1- 11.

Buldu, M. (2006). Young children's perceptionsof scientists: A preliminary study. *Educational Research, 48*(1), 121-132.

Cakir, M. (2008, October). Constructivist approaches to learning in science and their implications for science pedagogy: a literature review. *International Journal of Environmental & Science Education, 3*(4), 193-206.

Chambers, D. (1983). Stereotypic images of the scientist: The Draw-A-Scientist Test. *Science Education, 67*(2), 255-265.

Chionas, G., & Emvalotis, A. (2021). How Peruvian secondary students view scientists and their works: Ready, set, and draw! *International Journal of Education in Mathematics, Science, and Technology (IJEMST)*, 116-137.

Christidou, V., Bonoti, F., & Hatzinikita, V. (2023). Drawing a scientist: Using the Emo-DAST to explore emotional aspects of children's images of scientists. *Research in Science & Technological Education, 41*(4), 1287-1308.

Christidou, V., Hatzinikita, V., & Kouvatas, A. (2019). Public visual images of Greek scientists and science: tracing changes through time. *International Journal of Science Education Part B, 9*(1), 82-99.

D'Addezio, G., & Besker, N. (2024). Science and scientists from children's point of view: comparison and gender outlooks among 2011 and 2021 primary school student drawings. *Front. Educ., 8*(1179179), 1-17.

Dickson, M., McMinn, M., Cairns, D., & Osei-Tutu, S. (2021). Children's perceptions of scientists, and of themselves as scientists. *International Journal on Math, Science and Technology Education , 9*(1), 623-669.

Du Plessis, P. (2014). Problems and complexities in rural schools: Challenges of education and social development. *Mediterranean Journal of Social Sciences, 5*(20), 1109-1117.

Duarte, C., Jankowski, M., Tillotson, C., & Wilson, E. (2018). Assessing Namibia's STEM education: Focusing on the primary level. *An interactive qualifying Project submitted to the Faculty of Worcester Polytechnic Institute*.

Eastwell, P. (2002). The nature of science. *The Science Education Review, 1*(43), 43-48.

Emvalotis, A., & Koutsianou, A. (2018). Greek primary school students' images of scientists and their work: has anything changed? *Research in Science & Technological Education, 36*(1), 69-85.

Farland-Smith, D., Arquette, C., & Finson, K. (2017). How picture books on the national science teacher's association recommend list portray scientists. *School Science and Mathematics, 117*(6), 250-258.

Ferreira, J. (2011). Teaching life sciences to english second language learners: What do teachers do? *South African Journal of Education, 31*, 102-113.

Finson, K. (2003). Applicability of the DAST-C to the images of scientists drawin by students of different racial groups. *Journal of Elementary Science Education, 15*(1), 15-26.

Finson, K., Beaver, J., & Cramond, B. (1995). Development and field test of a checklist for the Draw-A-Scientist Test. *School Science and Mathematics, 95*(4), 195-205.

Finson, K., Farland-Smith, D., & Arquette, C. (2018). How scientists are portrayed in NSTA Recommends books. *The Hoosier Science Teacher, 40*(2), 47-63.

Hill, P., McQuillan, J., Hebets, E., Spiegel, A., & Diamond, J. (2018). Informal science experiences among urban and rural youth: Exploring differences at the intersections of socioeconomic status, gender and ethnicity. *JSTEM Outreach, 1*(1), 1-19.

Hilte, R. (2021). Differences and similarities in scientists'images among popular USA middle grades science textbooks. *European Journal of Mathematics and Science Education, 2*(2), 63-83.

Katukula, K. (2018). *Teaching methods in Science Education in Finland and Namibia*. Unpublished Masters thesis. University of Eastern Finland.

Kelly, L. (2018). An analysis of award-winning science trade books for children: Who are the scientists, and what is science? *Journal of Research in Science Teaching, 55*(8), 1188-1210.

Laubach, T., Crofford, G., & Marek, E. (2012). Exploring native American students' perceptions of scientists. *International Journal of Science Education, 34*(11), 1769-1794.

Leavy, A., Hourigan, M., & Cleary, C. (2023). From bespectacled, bearded and bald to explosions, potions and vaccines: Irish children's changing perceptions of scientists and the effect of the COVID-19 pandemic on those perceptions. *International Journal of Science Education, 45*(14), 1214-1239.

Leslie, S. J., Cimpian, A., Meyer, M., & Freeland, E. (2015). Expectations of brilliance underlie gender distributions across academic disciplines. *Science, 347*(6219), 262-265.

Martin, R., Sexton, C., Franklin, T., & Gerlovich, J. (2005). *Teaching science for all children.* Boston: Pearson.

Ministry of Education, Arts and Culture. (2017). *The national curriculum for basic education.* Okahandja: NIED.

Ministry of Education, Arts and Culture. (2023). *Natural science and health education syllabus grade 4-7.* Okahandja: NIED.

Monhardt, R. (2003). The image of the scientist through the eyes of Navajo children. *Journal of American Indian Education, 42*(3), 25-39.

Moore, J., Archer, L., J., D., & MacLeod, E. (2019). Comparing students' engineering and science aspirations from age 10 to 16: Investigating the role of gender, ethnicity,cultural capital, and attitudinal factors. *Journal of Engineering Education, 109*, 34-51.

Ozel, M. (2012). Children's images of scientists: Does grade level make a difference? *Educational Sciences: Theory and Practice, 12*(4), 3187-3198.

Pekmez, E. (2018). Primary school students' views about science, technology and engineering. *Educational Research and Reviews, 13*(2), 81-91.

Samaras, G., Bonoti, F., & Christidou, V. (2012). Exploring children's perceptions of scientists through drawings and interviews. *Social and Behavioural Sciences, 46*, 1541-1546.

Sánchez, J. (2024, September 02). *Science Spaces*. Inter-university Institute López Piñero: Spain.

Shikalepo, E. E. (2020). Challenges facing teaching at rural schools: A review of related literature. *International Journal of Research and Innovation in Social Science, 4*(5), 211-218.

Shivolo, T., & Mokiwa, H. (2024). Inquiry-based science education: Perspectives from Namibian teachers. *International Journal of Research in STEM Education, 6*(1), 97-112.

Thomson, M., Zakaria, Z., & Radut-Taciu, R. (2019). Perceptions of scientists and stereotypes through the eyes of young school children. *Hindawi Education Research International, 2019*, 1-13.

Toma, R., Orozco-Gómez, M., Niño, A., Obando-Correal, N., & Román, R. (2022). Testing assumptions of the Draw-a-Scientist-Test (DAST): Do stereotyped views affect career aspirations. *International Journal of Science Education, 44*(16), 2423-2441.

Zhai, J., Jocz, J., & Tan, A.-K. (2014). Am I like a scientist?: Primary children's images of doing science in school. *International Journal of Science Education, 36*(4), 553-576.

Zinger, D., Sandholtz, J., & Ringstaff, C. (2020). Teaching science in rural elementary schools: Affordances and constraints in the age of NGSS. *The Rural Educator, 41*(2), 14-30.