PRE–SERVICE TEACHERS' UNDERSTANDING OF HOW LEARNERS CAN BE DEVELOPED AND EQUIPPED WITH CONSTITUTIONAL VALUES WHEN TEACHING LIFE SCIENCES TOPICS

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ABSTRACT

Values education is value formation through education that is conveyed through educational goals usually set by curricular documents. Consistent with this, the National Curriculum Statement (NCS) Grades R–12, comprising the Curriculum Assessment and Policy Statement (CAPS), which is the currently used policy statement in South African schools, is underscored by a curriculum philosophy that urges teachers to "equip learners with values" during classroom teaching of all approved subjects. Hence, this study explored preservice teachers' understanding of how learners can be developed and equipped with constitutional values when teaching Life Sciences topics. A perception–value (P–V) theoretical framework was adapted to underpin the qualitative study. Data were initially derived from the NCS Grades R–12, comprising the CAPS for Life Sciences. Also, through a case study methodology, data were collected from responses to a values–education–driven assignment given to 70 pre–services teachers as participants. Both data sets were analysed and interpreted using analytical approaches involving content and thematic analyses (Bowen 2009). Results show participants' understanding regarding (i) identification of constitutional values incorporated in Life Sciences topics, either in correspondence with the content/concepts therein, or not; (ii) teaching strategies they can use to nurture the values identified in learners through classroom teaching of Life Sciences. Ultimately, this study created awareness of how teacher–educators could depict pre–service teachers' understanding of the curriculum (NCS) philosophy of equipping learners with values. This may enhance teacher–educators' understanding on how to teach pre–service teachers about using the teaching of Life Sciences concepts to foster values education.

Keywords: Perception, understanding, constitutional values, life sciences, equip with values, pre–service teachers

Introduction and background to study

Values education refers to "value formation through education", which is conveyed through educational goals usually set by curricular documents (Oeschger et al. 2022). Consistent with this, the NCS Grades R–12 (NCS), comprising the CAPS, which is the currently used policy statement in South African schools, is underscored by a curriculum principle that urges teachers to equip learners with values during classroom teaching of all approved subjects (Department of Basic Education [DBE] 2011a). Notably, since the start of democracy, school curricular documents in South Africa have been built on 10 fundamental social values that inspired the country's Constitution Act 108 of 1996 (The South African Constitution 1996 as amended). These social values comprise democracy, social justice and equity, equality, non–racism, and non–sexism, Ubuntu (human dignity), open society, accountability, rule of law, respect, and reconciliation (Department of Education [DoE] 2001, 3—4; Dube 2020). The Manifesto on Values, Education and Democracy (MVED) accentuates these values (DoE, 2001). Therefore, to fulfil educational outcomes, the commitment of teachers is required, especially to implement the South African national curriculum principles which are inclined towards promoting values education. Nevertheless, "teacher training is faced with the challenge of training sensible, creative, and proactive professionals who think critically" (García-Gonzále, Rocío and Azcárate 2020). This concern covers training of pre–service teachers who can critically think about, understand and translate curricular principles, such as the one enshrined in the NCS. Correspondingly, this process starts from pre–service teacher–educators' awareness of how pre–services teachers "perceive" such curricular principles.

Hence, this study explored preservice teachers' perceptions of nurturing constitutional values in learners through classroom teaching of Life Sciences concepts in South African schools. In the context of this study, we consider an initial operational definition for perception as the way one thinks about something (an idea, notion, or phenomenon) and how it is understood or interpreted (Ou 2017). Accordingly, perception "deals with developing both *objective and subjective meanings* for people, events, and objects, and a culture's hierarchy of values influences people's perceptions in that culture" (Ou 2017, 18). We view this as the way an individual develops objective and

subjective meanings (perception) impacts or is interrelated with how such meanings are understood (understanding) (Zashchirinskaia 2020). In the same vein, various studies have reported on the values that are most relevant to teach in schools to promote values education (Berkowitz 2011; Gökçe, 2021; Espinosa and González, 2023). The values included are not limited to respect, equality, responsibility, self–discipline, honesty, courage, democracy, generosity, fairness, charity, humaneness, and patriotism. In their study, Espinosa and González (2023) examined preservice teachers' perception with respect to underpinning core values students must acquire at schools.

However, these authors pointed out that there is a "lack of clarity about conceptual issues relevant to values" (Espinosa and González 2023, 1). We reckon that one of these conceptual issues pertained to pre–service teachers' perception or conceptualisation of how values may be nurtured in learners through classroom teaching. Berkowitz (2011) suggested the "inculcating values" approach, which involves teachers directly instilling values in learners, using techniques such as narration and discussion methods to persuade learners to internalise such values. Nonetheless, how teachers perceive or conceptualise the notion of inculcating values in learners may have been overlooked. According to García–González et al. (2020), education plays an important role in ensuring that learners acquire the practical and theoretical skills they need; and how values education plays a significant role in this case is germane. More specifically, it is important to figure out how future teachers perceive important components of values education such as the values–driven principle of "equipping learners with values" incorporated in the NCS. We view that as future facilitators or activators of classroom teaching and final implementers of the curriculum, it is pertinent that pre–service teachers understand how to promote values education through nurturing learners with values during classroom teaching. Notwithstanding, the way pre–service teachers think about this conception is germane to achieving intended educational outcomes. This study thus becomes significant resulting from the limited empirical research on how teachers perceive values in the school environment (Oeschger et al., 2022). Consequently, the study was guided by the research question: What are pre–service teachers' perceptions/understanding of nurturing constitutional values in learners through classroom teaching of Life Sciences concepts?

Therefore, this article is structured as follows: In Section 1, we introduce and provide a background that establishes values education as the premise upon which the study was situated; and more importantly how pre–service teachers perceive the NCS principle of equipping learners with values. In Section 2, we provide a review of literature on the support of curricular documents for values education and specifically how the NCS does this through its principle of "equipping

learners with values". Despite this, we pointed out a gap in the literature pertaining to how studies may have overlooked pre–service teachers' perception of an important aspect of values education regarding how learners may be equipped with values during classroom teaching of Life Sciences. Section 3 presents the theoretical framework that underpinned the study. The framework considers an adaptation of the constructivist perspectives of theories (coined as Perception–Value (PV) theory) through .the interlink between the concepts of "perception" and "value(s)" (Foad, Maio and Hanel 2021). The methodology adopted in the study is explained in Section 4. This comprised a qualitative approach which drew from interpretivist and constructivist paradigms through which we sought to probe the "minds" of the participants using the case study methodology. Through using the themes that emerged during data analysis, we present the results of the study in Section 5. Discussions on these results on how pre–service teachers thought about (perceived) the NCS, Grades R–12 philosophy of equipping learners with values; and what teaching strategies may be suitable for its integration particularly into classroom teaching of Life Sciences are offered in Section 6 of the article.

LITERATURE REVIEW

Scholars have either defined or described "values education" in different ways (Berkowitz 2011; Akan 2021). It is stated that "whereas explicit values education refers to schools' official curriculum of what and how to teach values and morality, including teachers' explicit intentions and practices of values education, implicit values education is associated with a hidden curriculum and implicit values, embedded in school and classroom practices" (Thornberg and Oğuz 2013, 49). However, Ferreira and Schulze (2014) found in their study that there was a lacuna in what the curriculum intends (the intended curriculum) and teachers' perceptions of nurturing values in learners through values education. Moreover, this hiatus is related to teachers' inadequate understanding of the concept. The motivation for the present study is premised on this background. Mohamad et al. (2019) reviewed extant studies pertaining to teachers' perception of nurturing values in learners through implementation of values education in schools. The study presented findings regarding barriers and challenges which teachers encounter and the need to support them in this direction. Katılmış (2017) reported pre–service teachers' perception with respect to what the objectives of values education are, especially in terms of building and developing individuals who have imbibed appropriate values to then become virtuous citizens of their nations. In other words, these scholars reported on how inculcating values in learners may be enhanced through

values education. Nonetheless, none of the above studies dealt with pre–service teachers' perception of nurturing values in learners through classroom teaching of Life Sciences. It is this gap in the literature that the current study intends to fill.

At the level of schooling contexts, values are transmitted through educational goals set by curricular documents; and this usually resonates globally as educational standards (Oeschger et al. 2022). Thus, nurturing values in learners through values education is underscored by how teachers are able to understand the principle. As facilitators of classroom teaching and learning, teachers have a role that is germane to achieving value education goals. This proposition implies that the successful implementation of the curriculum by educators affects the effectiveness of nurturing values in learners through values education. Therefore, because of repressive colonial and apartheid regimes, a democratic Republic of South Africa may have embraced values education as part of an initiative targeted at identifying values to be included in the South African curriculum (Ferreira and Schulze 2014). This initiative climaxed in a values–driven document titled "The Manifesto on Values, Education and Democracy" (MVED) (DoE 2001) that emphasised the earlier–mentioned fundamental values that became well–entrenched in the nation's democratic Constitution (Act 108 of 1996). However, "empirical research into how values are structurally reflected in school curricula and how these values are perceived in the school environment by teachers is very limited" (Oeschger et al. 2022, 1). The focus of the current study intends to cover this limitation.

Similarly, the NCS, Grades R–12 policy statement is undergirded by a curriculum philosophy which stipulates that teachers are to equip learners with values such as inclusivity, human rights, social and environmental justice, etc. as established in the Constitution of the Republic of South Africa (Acts 108 0f 1996) (DBE 2011a). More so, what and how teachers think about inculcating appropriate social values in leaners may not be under–emphasised. Consequently, as pre–service teacher educators, we undertook the current study based on how pre–service teachers perceive the NCS's curriculum philosophy of "equipping learners with values" through classroom teaching of Life Sciences.

THEORETICAL BACKGROUND

Considering interlink between the concepts of "perception" and "value(s)" (Foad et al. 2021), this study was underpinned by an adaptation of the constructivist perspectives of theories on the two concepts (coined as Perception–Value (PV) theory). As will be further expounded, the theories on these two concepts are amenable to this study as a result of both being associated with human

behaviours (Ou 2017; Foad et al. 2021; Nes et al. 2023). Hence, we considered theories which underline behavioural thoughts (perceptions) of pre–service teachers pertaining to the NCS's value–driven curriculum philosophy of instilling values in learners. Firstly, each of the concepts is examined separately; and then we elucidate how they intersect to form the theoretical framework that underpinned the study. The word "perception" emerged from the Latin words *perceptio, percipio*, meaning an action related to receiving, possessing, and processing information for appropriate comprehension of the mind or senses (Ou 2017). The concept of perception has been described in the literature in various ways (Démuth 2013; Ou 2017, Nes et al. 2023). Generally, these scholars agree that perception comprises psychological processes, involving behaviours, through which perpetual experience is gained on the account of processing of and interpreting information by action of the five senses (tasting, seeing, touching, smelling, and hearing). It is stated that "most relevant theories and explanations of perception [view it] as a process of acquiring and processing of information" (Démuth 2013, 23). This is consistent with the notion posited by Ou (2017, 18) that perception is the "process of attaining awareness or understanding of sensory information".

Furthermore, we adopt the three stages of *selection, organization, and interpretation*, involved in the perception process proposed by Ou (2017). The first stage involves *selection (stimulation),* during which an individual comes in contact with a stimulus (e.g. an idea or notion) using any or all of the five senses. This forms the bedrock of the concept of perception upon which the other stages rely. Thus, a stimulus found within the surrounding of the individual stimulates the senses; and is converted into conscious experience or awareness through a selective process. Being *sine qua non*, the NCS/CAPS policy statement is thus the stimulus within the environment of the pre–service teacher–participants in the study. Moreover, the task given to the pre–service teachers required them to "select" and work with any Life Sciences topic/concepts of their choice from the policy statement. We consider that the pre–service teachers' "sense of sight" was stimulated by their engagement with the policy statement, and this may have raised their awareness regarding the curriculum philosophy. In addition, the stimulation was accompanied by "selective attention and selective exposure" since the pre–service teachers were engaged with what fulfilled a certain assignment need, leading to positive perception (Kizilirmak, et al. 2022).

The second stage of perception is *organisation or categorisation,* during which meaningful patterns are established in the information selected from the stimuli that stimulated an individual's senses. This brings about familiarity and hence the development of schemata arising from such

exposure and experience (Barbot 2018). By development of schemata, the pre–service teachers organise and structure their knowledge (Liu 2015) regarding the focus of the assignment. Therefore, we view that through stimulation facilitated by engagement with the policy statement (stimulus), and by their selection of topics, the pre–service teachers organise their thoughts as they respond to the focus of the assignment. The third stage of perception, known as interpretation (or *interpretation–evaluation*), involves "attaching meaning to the selected stimuli; to make sense of [identified] patterns by assigning meaning to them" (Ou 2017, 19). Therefore, we believe the pre–service teachers categorise and structure the stimuli selected into meaningful patterns, and try to make sense of such patterns in relation to the focus of the assignment. The interpretation–evaluation stage underscores the pre–service teachers' memory regarding the storage, repository, and retrieval (recall) of information on the assignment. Accordingly, this stage is guided, among others, by an individual's experiences, focus, expectations, and values (Ou 2017; Foad et al. 2021). Value(s) is a "conceptualisation" (Kluckhohn 1951, 395) that is abstract and difficult to grasp (Seewann and Verwiebe, 2020). However, value(s) act as motivations by which individuals evaluate and justify situations, ideas, people etc. as desirable or otherwise; and hence guide behaviours (Skimina Cieciusch and Strus 2021; Gamage et al. 2021). Sociocultural contexts are usually domains of a repertoire of values which impact social and personal values (Gamage et al. 2021). Individuals are thus inculcated with and internalise values that are prevalent within the sociocultural contexts in which they develop. It is arguable that preservice teachers are also initially influenced by cultural values imbued in them, from childhood, by the sociocultural contexts in which they developed. They bring these values with them to the teacher training programme, where they acquire professional values that may buttress or transform their cultural values (Gökçe 2021). Hence, pre–service teachers' cultural/professional values may provide an understanding of their perception (Foad et al. 2021), and perception of the values learners should acquire (Gökçe 2021). These assertions are consistent with the focus of the assignment for which the pre–service teachers provided responses regarding the NCS's policy statement of nurturing learners with values. As products of drafters within the sociocultural contexts in which they are utilised, curricular documents are also value–driven and espouse certain values (Oeschger et al. 2022). In this respect, the NCS, Grades R–12 (comprising the CAPS for Life Sciences) policy statement employed in this study, is value–driven, as previously stated. Consequently, the discussions in this section underscore Figure 1 above to explain how a Perception–Value (PV) theoretical background underpinned the study. Accordingly, Gamage, et al. (2021, 1) stated that "values can be seen as the

perceptions of psychological expressions or frame of mind".

METHODOLOGY

A qualitative approach was employed to explore the mind–set of pre–service teachers in a South African university pertaining to their perceptions of the NCS's curriculum philosophy of "equipping learners with values". The approach drew from interpretivist and constructivist paradigms through which we sought to probe the "minds" of participants regarding their viewpoints on the curriculum philosophy. Consequently, we adopted the case study (Yin 2017) methodology to qualitative study. Therefore, the "case" represents a bounded system (Merriam and Tisdell 2015) in which pre–service teachers' perceptions of the curriculum philosophy of "equipping learners with values" epitomised the phenomenon investigated; while the NCS, Grades R–12, comprising the CAPS for Life Sciences portrayed the context.

Participants

The participants in the study comprised 70 pre–service teachers who were final–year students enrolled for a Bachelor of Education (B.Ed.) degree programme at the university under reference. The pre–service teachers registered for a methodology course on the teaching of Life Sciences in high schools. All the participants consented to participating in the study.

Data collection and analysis

Prior to the study, the authors (as teacher–educators) employed Bowen's (2009) approach to document analysis to collect and analyse data derived from the NCS, Grades R–12, comprising the CAPS for Life Sciences. Our focus was to understand what the curriculum philosophy of "equipping learners with values" connotes; and how it can be conceptualised for classroom teaching of Life Sciences. Three iterative steps of skimming (superficial examination), reading (thorough examination) and interpretation, which incorporated components of content and thematic analysis, were involved in the document analysis. Initially, each of the authors did "skimming" individually three times, during which we examined all the four content sections in the policy statement superficially. During this process, we highlighted textural data, which provided relevant information regarding the above foci. Thereafter, we discussed and compared notes regarding areas of similarity and/or divergence in our findings. From our discussions, we reached a conclusion that the following two sections contained textural data, which provided relevant information related to

the above foci: Section 1 – Introduction to the curriculum and assessment policy statement; and Section 3 – Content. After the skimming process, we thoroughly examined and explored the above sections further individually three times. We highlighted textural data, which provided relevant information regarding our foci; and also discussed and compared notes as done after the skimming session. We concluded that Section 1, subsection 1.3 — General aims of the South African Curriculum — contained the most appropriate data related to understanding what the curriculum philosophy meant.

Certain topics were also selected from Section 3 and these represented data that supplied information on how the curriculum philosophy may be conceptualised for classroom Life Sciences teaching. Both data sets were analysed through content and thematic analyses (explained below). Plausibly, back–and–forth skimming and thorough reading was done for the entire document analysis process. The 10 fundamental constitutional values highlighted and enunciated in the MVED were used as pre–codes with which we identified values that are incorporated in the selected Life Sciences topics that were examined. Arising from our findings, we taught and discussed curriculum philosophy with the pre–service teachers during a one–hour lecture period, after which they were given an assignment. Below (Italicised) is a detailed account of the task. In addition, the pre–service teachers were given adequate time (four weeks) to research and prepare their assignments before submitting. Data collected from these submissions, and analysed, formed the basis of our study.

> "Read the attached extract from the Manifesto on Values Education and Democracy (MVED). The full document is also attached for your identification of values. Using the Curriculum and Assessment Policy Statement (CAPS) for FET Life Sciences choose a topic/concept from any grade (Grades 10–12) and identify from the MVED extract the values you can inculcate in learners whilst teaching the topic/concept. Critically discuss how such values may be integrated into Life Sciences classroom teaching of the chosen topic/concept(s)."

Therefore, after submission, further examination of the data derived from the pre–service teachers' responses to the task followed the procedures described above. In this case, each participant's submitted response, either in word or pdf file, was treated as a "document" containing data collected. Initially, to get acquainted with the responses, each of the authors separately skimmed through each of the students' documents twice. During this process, we highlighted areas in the data which provided information germane to participants' understanding regarding:

(i) identification of constitutional values incorporated in their chosen topics either in correspondence/consonant/agreement/consistent with the content/concepts therein or not; (ii) teaching strategies that can be used to inculcate/nurture the values identified in learners through classroom teaching of the topics/concept(s). These areas of focus were further consolidated during thorough reading, which was also done separately but twice by each of the authors. As explained above, consultations were made by the authors after the skimming and through reading exercises. The skimming, thorough reading and coding formed an important aspect of content analysis which involved "organising information into categories related to the central questions of the research" (Bowen 2009, 32). However, how values are enunciated in the MVED (DoE, 2001) formed the framework for identification of constitutional values incorporated in the chosen topics

Data analysis

Data analytical approaches involving content and thematic analyses (Bowen 2009), assisted us in interpreting the data we collected from Section 1, subsection 1.3 (General aims of the South African Curriculum,) and the topics selected from Section 3 (content) of the Life Sciences curriculum. These approaches were also adopted to analyse the data collected from the pre–service teachers' responses to the assignment. Through thematic analysis, we performed "coding and category construction based on the data's characteristics, to uncover themes pertinent to a phenomenon" (Bowen 2009, 32). Hence, we re–examined data which presented students' responses consistent with the two areas mentioned above. The two areas mentioned above formed the major codes that guided the coding process. Coding served as a process in qualitative analysis, which interlinked data collection and its interpretation (Charmaz 2006). Patterns which resulted from the codes were considered as categories of information from which the themes emerged. Therefore, values identified from the content and concepts inherent in Life Sciences topics chosen were categorised accordingly. We did a back–and–forth interplay with the data by carefully rereading and reviewing the codes and categories. Through thematic analysis, patterns within the data portraying emerging themes were recognised. Table 1 that follows shows an example of how data were analysed to determine pre–service teachers' perceptions on (i) identification of constitutional values incorporated in their chosen topics either in correspondence with the content/concepts therein or not; and (ii) teaching strategies they can use to inculcate/nurture the values identified in learners through classroom teaching of the topics/concept(s). This analysis informs the themes under which the findings are presented.

Table 1: An example of how data were analysed to determine pre–service teachers' understanding

Topic/concepts selected	Teaching strategies that can be used to nurture values in learners/explanation of content in relation to value	Identified values
Human reproduction • Teenage pregnancy • Abortion • Contraceptives	• Connecting content to learners' personal experiences. • Role–playing: ➢ Acting as healthcare workers and pregnant persons to depict societal problems. • Discussions in groups. • Active participation in classrooms	• Empathy • Respect for diverse • perspectives • Non–discrimination • Social justice
The human ear • Role of each part of the ear • Deafness due to one part (e.g. the cochlea) not functioning due to damage or disease	• Giving examples of societal systems where different people or professionals work towards the achievement of the same goals, e.g. ➢ Different health workers in hospitals, doctors (e.g. anaesthetists, surgeons, paediatrics, gynaecologists), nurses, cleaners etc.	• Equality • Non–racism • Non–sexism • Respect

Results

In this section, we present the results delineated by themes (as stated above) that emerged from our analysis. The names used are pseudonyms to represent the pre–service teachers involved.

Theme 1: Identification of constitutional values in direct correspondence with the content/concepts. Excerpt 1 below indicates an example of how this theme was expressed in Thato's response.

> **Thato**: "…Through the concept of Light phase and Dark phase of Photosynthesis, the value of **Ubuntu** can be taught, **the Dark phase which is also known as the light independent phase cannot take place without the "help" of the Light phase, even though the phase that does not depend on light,** It does depend on the light phase in order for it to take place. The dark phase requires energy–rich hydrogen atoms formed in the light phase as well as the energy released from ATP which was also produced in the light phase for it to produce glucose as the by–product of photosynthesis. Same way as humans need help from each other to fulfil their goals, hence in this concept learners can learn the value of Ubuntu which embodies the concept of mutual understanding and being humane in helping one another."

Explanations/interpretation

In the above excerpt, the student made reference to the relevant concept(s) to suggest which

constitutional values may be taught while teaching the topic in question. In this instance, reference was made to the "light–dependent" (LDS) and "light–independent" (LIdS) phases of the process of photosynthesis. Whereas, photosynthesis comprises photochemical and enzymatic reactions, the chlorophyll in green plants must first absorb light energy. This results in the eventual generation and formation of the (NADPH) which, essentially, in conjunction with ATP, drive the light–independent stage. The LIdS or the Calvin cycle, during which glucose is generated using carbon dioxide, does not require light. Therefore, as the LDS is interdependent on the LIdS and vice versa, so is such "interdependence" reflected in the philosophy of Ubuntu (*You are because I am*).

Theme 2: Identification of constitutional values not in direct correspondence with the content/concepts. Excerpt 2 below indicates an example of how this theme was expressed in Debora's response.

> **Debora. "…**In this essay, I will discuss how the Grade 11–12 Life Sciences topic of human impact on the environment can be used to nurture the values of respect and responsibility in learners. …Respect is regarded as a necessary value for effective communication, cooperation, and efficiency. This suggests that effective teaching and learning will require mutual respect among educational stakeholders, specifically between the instructor and the learners. As a result, this value can help learners develop into individuals who can operate well in society and the workplace. … the importance of responsibility, revealing that students understand their entitlement to an education and that they must respect teachers and peers, be on time for class, participate in and finish learning activities, and study. These values, however, apply to all educational stakeholders. For example, it is the teacher's responsibility to ensure successful teaching and learning by arriving on time and preparing for class."

Explanations/interpretation

The constitutional values of respect and responsibility are well–incorporated into the topic of "Human impact on the environment", as correctly identified by Debora. However, unlike Thato in Excerpt 1 above, she did not relate the values identified to concepts embedded in the topic. In this instance, the student only identified, for example the value of respect, in terms of how teaching and learning may be enhanced if mutual respect is promoted between the stakeholders within educational contexts and learners. We consider that Debora's perception may have centred on identification of values of respect and responsibility from the topic in terms of human respect for and responsibility towards the environment through activities, for example, reducing her carbon footprint, afforestation, proper waste disposal, going green, reducing dangerous gas emissions etc.

Theme 3: Teaching strategies involving classroom activities in direct correspondence with topic. Excerpt 3 below explicates an example of how this theme was expressed in Johnson's response.

> **Johnson. "…**The first value being **equality** can be integrated when teaching about the structure of the human ear. Here the teacher can draw the structure of outer, middle and inner parts of the human ear. After that he or she can describe how sound waves travel from the outer ear until they reach the inner ear, and explain why a person cannot hear if one of the parts does not work. For example, when the cochlea found in the inner ear is damaged. This will make learners to realize that all parts of the ear are equally important to make a person to hear sound. The teacher can then relate this to the society and tell learners that all people in the society are equally important to make the society work. For example, clinics need nurses, cleaners, doctors and patients so that they can function efficiently [in the society]"

Explanations/interpretation

In the above excerpt, Johnson suggested the use of drawings and illustrations as a teaching strategy to teach the value of **equality** incorporated in the topic of the "ear". However, in such illustrations/drawings, the student noted the importance and role played by the different parts of the ear for sound waves to be detected. In essence, all the parts are of equal importance for sound waves to be transmitted and detected appropriately.

Theme 4: Teaching strategies involving classroom activities not in direct correspondence with the topic. Excerpt 4 below enumerates an example of how this theme was expressed in Debora's response (Refer to Excerpt 2 above).

> **Aliyah "…**I will ask the learners to discuss ways to use water to prevent water from running out and While one learner is speaking, I will urge the others to actively listen by posing follow–up questions or asking them to summarize what their peer said. …so, I will provide a platform for learners to contribute their ideas, making them a part of the lesson, which will encourage meaningful learning of the topic and help them comprehend, appreciate, and respect the different viewpoints of their peers**."**

Explanations/interpretation

Debora's perception above regarding strategies to teach the values of respect and responsibility was not in terms of relating the values in direct correspondence with the concepts. In this regard, the learners are expected to discuss the topic and not in any relation with the values. From Table 1 it shows that the teaching approaches identified by participants enhance interactive and learner–centred classrooms, and the use of real–life examples and scenarios, which enable learners to

engage in reflections which one of the participants referred to as "making ethical reflections".

Theme 5: Teaching strategies involving outside–class activities. Excerpt 5 below enumerates an example of how this theme was expressed in Lucky's response.

> **Lucky. "…**As we discuss the water availability subtopic in class, I would encourage the learners by asking them if they have experienced any issues when it comes to water availability in their areas and what they think could be the cause for such an issue. …The learners can go to the municipal offices to enquire in order to get valid responses. Considering that as teachers we have a responsibility of being role models and lead by example, I would also go to the relevant offices to help learners find the information we need. This will teach learners how important participation is in the context of nation building."

Explanations/interpretation

Unlike in Themes 3 and 4 above, Lucky suggested a teaching strategy that will take the learners outside of the classroom environment. This teaching strategy is in relation to a Grade 11 topic on "Human Impact on the Environment: Current Crises for Human Survival: Problems to be solved within the next generation" (DBE, 2011, p. 51) with a specific focus on water availability and its quality. Hence, the strategy involves a visit to the municipal office in charge of water supply to find out about issues related to water availability or shortages. This relates to the way South Africa has been experiencing erratic power supply, coupled with a shortage of water supply. According to Lucky, this strategy will be useful to teach learners about the values of responsibility/accountability "because there was someone [in the municipal office] who had a responsibility and they failed to take accountability for it".

DISCUSSIONS AND CONCLUSIONS

There has been recent awareness of and attention to pre–service teachers' research in teacher education targeted at reinforcing quality of teaching (Van Katwijk, Jansen,and Klaas 2023). Our study reports on how pre–service teachers thought about (perceived) the NCS, Grades R–12 philosophy of equipping learners with values; and what teaching strategies may be suitable for its integration particularly into classroom teaching of Life Sciences. It has been stated that "using practitioner inquiry as a professional learning strategy can help pre–service teachers, teachers and teacher educators become more aware of setting and achieving goals and substantiate their efforts by relying on scientific knowledge produced by others" (Van Katwijk et al. 2023, 435). Hence, our study becomes germane to the research considering that, as teachers–in–training, the NCS, Grades

R–12 is *sine qua non* for all prospective teachers within the South African schooling contexts. Moreover, since our study is based on a curriculum philosophy underlined by this policy statement, the findings in our study may be of immense benefit to pre– and in–service teachers. Additionally, what is significant to the science curriculum includes critical features or major philosophical underpinnings (Levinson 2018) of the educational resource. Such critical features are underscored by the above curriculum philosophy. Stanford and Starr (2017) stated that findings of absence of a link between curriculum theory and practice, on the one hand, and a professional approach to the curriculum on the other hand, in the accounts of pre–service teachers, call for renewed efforts on curriculum discourses. Therefore, how pre–service teachers understood the underlying philosophies that guide the curriculum in use within contexts of their training and possible professional quest formed the fulcrum of discourse in this study.

Contingent upon the above, a balanced curriculum theory and teacher practice is essential in a post–apartheid South Africa considering the process of socio–political curriculum transformations which birthed a values–driven policy statement inspired by a values–driven democratic Constitution (Acts 108 of 1996). Notwithstanding that these two policy documents are established on democratic values, cases of injustice, racial discrimination and human rights abuses are still prevalent 20 years into democracy (Roux and Janse van Rensburg 2017). In light of this situation, "the explicit development and teaching of applicable and appropriate values have become an urgent need" (Roux and Dasoo 2020, 1). In these circumstances, our study stresses the need and benefits derivable through teacher–training programmes that ensure pre–service teachers engage in unambiguous values–inclined pedagogies. Consistent with this, Curtis (2015, 313) stated that "if teachers are better prepared in the values dimension of teaching, this will make them more holistic quality teachers, which will in turn positively impact upon student achievement and well–being". In addition, pre–service teachers' perception about values, particularly pertaining to teaching as a profession, impacts their professional development (Xiaofei et al. 2023) and their views on values education (Oguz 2012). We argue that an important first step to ensuring a values dimension of teaching (values education) for pre–service teachers is to understand how they perceive the idea; and this explicates our study.

Furthermore, values education, which entails the teaching of values, is incorporated in the Life Orientation (LO) curriculum of the Senior Phase (Grades 7–9) in South Africa (Maphalala and Mpofu 2018). According to the CAPS for Further Education and Training (FET) (Grades 10–12) Life Orientation (LO), the subject deals with the "study of the self in relation to others and to

society [and] it addresses skills, knowledge, and values about the self, the environment, responsible citizenship, a healthy and productive life, social engagement, recreation and physical activity, careers and career choices" (DBE 2011b, 8). Accordingly, all the approved topics in this policy statement are closely related to those in curricula of other phases (Grades R – 9) of schooling in South Africa because they all focus on similar areas of values, skills, and knowledge. It is therefore arguable that the 10 fundamental values enshrined in the Constitution of South Africa (Act 108 of 1996) are incorporated and well–reflected in all the following six main topics approved in the LO policy statement: "1) Development of the self in society 2) Social and environmental responsibility 3) Democracy and human rights 4) Careers and career choices 5) Study skills 6) Physical Education" (DBE 2011b, 8). However, such a well–articulated topic–value position is not the case with the CAPS for Life Sciences, considering there are scientific concepts embedded within the approved topics. In essence, the 10 fundamental constitutional values are not directly expressed in the topics when compared with those in LO. Consequently, we are of the view that teachers most likely perceive that teaching of values applies only to a subject such as Life Orientation. Thus, teaching of values may have been unconsciously restricted to the teaching of LO.

Nonetheless, our study creates an awareness that teaching of values can be done through topics in Life Sciences. Accordingly, Thato (See Theme 1 under the last section) perceived that through the concept of the light phase and dark phase of photosynthesis, the value of Ubuntu can be taught. The dark phase, which is also known as the light–independent phase, cannot take place without the "help" of the light phase, even though the former phase does not depend on light. In other words, learners may be inculcated with the constitutional value of *Ubuntu* (depicting interdependence) through teaching of the topic of photosynthesis. Additionally, the study reports the pre–service teachers' level of understanding of teaching strategies that may help to nurture learners with values during classroom Life Sciences teaching. Whether through strategies that involve in–class or out–class activities, we propose that nurturing learners with values should be in direct relation to or in correspondence with the concepts intended for teaching. For example, in nurturing the value of *equality* during teaching of the concept of "response to stimuli through the ear", Johnson (See Theme 3), perceived that the

> "teacher can draw the structure of outer, middle, and inner parts of the human ear. After that he or she can describe how sound waves travel from the outer ear until they reach the inner ear and explain why a person cannot hear if one of the parts does not work, for example, when the cochlea found in the inner ear is damaged…"

Ultimately, this study created awareness on how teacher–educators could depict pre–service teachers' understanding of the curriculum (NCS) philosophy of "equipping learners with values". This may enhance teacher educators' understanding on how to teach pre–service teachers about using the teaching of Life Sciences concepts to foster values education. In the same vein, further research is intended by the authors to investigate how findings in this study are applicable to other subjects beyond Life Sciences. In this regard, curriculum analyses of the CAPS for Natural Sciences (especially the chemistry and physics components) are intended to identify and characterize constitutional values espoused by its content and concepts.

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