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The Analysis of Natural Science Lesson-Plans Integrating the Principles of Transformative Pedagogy

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Abstract. This paper investigated how graduating Natural Science pre-service teachers were able to integrate the principles of Transformative Pedagogy in their lesson-plan designs. The study draws on the theoretical tenets of Transformative Pedagogy, a form of pedagogy that combines social constructivism and critical theory, in order to teach for equity and equality. The study was qualitative in nature; it and made use of a documentary analytical method to respond to the primary research question: how do graduating Natural Science pre-service teachers integrate the principles of Transformative Pedagogy in their lesson-plan designs? To respond to this primary research question, descriptive text that derived from the purposely selected sample of lesson-plan designs of the pre-service teachers was analysed. An analysis of the three-lesson plan designs revealed that the principles of Transformative Pedagogy, namely the “prompting of learners’ critical consciousness about social issues”, “the existence of open-dialogue amongst learners” and “learners’ engagement in educational collaborative practices” were thoughtfully considered and integrated within the lesson-plan designs. Based on the findings, this study holds a series of implications for future research in the scholarship of pre-service teacher development, especially in the field of science education. Given the ideals of Transformative Pedagogy, future research could focus on the capability of pre-service teachers to infuse the principles of Transformative Pedagogy in other science-related school subjects, such as Physical science and Chemistry teaching. Future research could also perhaps explore how pre-service teachers experience the integration of Transformative Pedagogy in their lessons.

Keywords: Natural Science education; pre-service teacher development; Transformative Pedagogy; lesson planning; Initial Teacher Education

1. Introduction

Initial Teacher-Education Programmes should provide pre-service teachers in development with a well-rounded education that would equip graduates with an integrated knowledge base that enables them to demonstrate applied teacher-competence, commitment and responsibility, as academically and professionally qualified educators (Bourke, 2019). In the context of Natural-Science teacher education, the integrated knowledge base is the ability of pre-service teachers to demonstrate a mastery of Natural-Science subject-content knowledge, knowledge of the learners and their educational contexts in the Natural-Science classroom and a pedagogical content knowledge base that is specifically aligned to the nature of the subject Natural Science (Hetherington & Wegerif, 2018). As a middle-school subject, Natural Science forms the basis of applied sciences that focuses on the rules of nature and the study of the universe.

In addition to pre-service teachers' mastery of an integrated knowledge base, the expectation is also for graduating pre-service teachers to be able to demonstrate the ability to structure meaningful lesson plans that would give expression to an effective Natural Science educational experience. The lesson plan, which encompasses an in-depth description of the instructional strategies and learning activities to be performed in the teaching and learning scenario (Ahmad, Yakob & Ahmad, 2018), includes various core lesson-plan features that are associated with a teaching episode. These features, amongst others, include information about the lesson topic selected, the lesson objectives formulated, the teaching approach followed, teaching materials considered and the assessment methods selected (König et al., 2020).

Furthermore, apart from lesson-plan features, it is also expected that the pre-service teacher should be knowledgeable of various educational-learning theories that could help them improve their lesson-plan design (Civitillo, Juang & Schachner, 2018). Generally, the three most widely accepted theories to learning are Constructivism (i.e., learners being the constructors of knowledge), Social Constructivism (i.e., learners acquiring knowledge through social interaction with their fellow peers) and Behaviourism (i.e., learners acquiring knowledge through a stimulus-response-reinforcement method) (Clark, 2018).

The ability of the pre-service teacher to draw on these theories would affect the didactic condition of the lesson. In other words, the selection of a particular learning theory influences how the lesson activity would unravel in the classroom context; and it would consequently impact how learners experience the learning and teaching process.

Aside from these common learning theories, an alternative educational theory deemed highly appropriate for promoting a "socially just" educational experience, deals with a pre-service teacher's ability to infuse Transformative Pedagogy into a lesson-plan design. Transformative Pedagogy is considered to be a form of pedagogy that combines social constructivism and critical theory; and one which focuses on a pre-service teacher's ability to teach for equity and equality (Tinning, 2017).

Using Transformative Pedagogy implies that the pre-service teacher is interested in teaching in a manner that would raise awareness amongst learners of those factors that negatively downplay equity and equality in society (Lynch & Curtner-Smith, 2019).

Given this understanding of Transformative Pedagogy, the Minimum Requirements for Teacher-Education Qualification (MRTEQ) policy, which governs the processes and practices related to teacher education in South Africa (Department of Higher Education, 2015), reiterates the importance of Initial Teacher-Education programmes exposing pre-service teachers to the key theoretical tenets of Transformative Pedagogy. Given this call, the School of Education at a selected South African University, is committed to equipping pre-service teachers with an integrated knowledge base that would enable them to perform quality teaching duties with the values and norms of social justice and human rights in mind.

However, given this programme expectation, little research has been done by us as teacher educators in the School of Education, in order to determine whether pre-service teachers were able to integrate such norms and values into their lesson-plan designs. Doing so is important; since the pre-service teachers' lesson-plan designs ultimately inform their teaching practice during a teaching-practicum experience (Lynch & Curtner-Smith, 2019). It is with this argument in mind that we ask the following question: "how do graduating Natural Science pre-service teachers integrate the principles of Transformative Pedagogy into their lesson-plan designs?" In posing this question, our thinking was guided by the purpose of the study, which was to determine the ability of graduating pre-service teachers to integrate the principles of Transformative Pedagogy into their Natural-Science lesson-plan designs.

2. The Literature Review: Transformative Pedagogy as a Theoretical Lens

This study draws on the theoretical tenets of Transformative Pedagogy. This is a form of pedagogy that combines social constructivism and critical theory. It focusses on teaching for equity and equality (Tinning, 2017). The implementation of Transformative Pedagogy allows for didactic conditions to occur within a teaching context (Branchetti & Rossi, 2021). These didactic conditions, according to Mezirow (1997), include learners undergoing a process of perspective transformation, which is articulated across three dimensions. These dimensions include the psychological dimension (i.e., learners' transforming how they perceive the "self"), a convictional dimension (i.e., learners critically reflecting on their own beliefs and values), and a behavioural dimension (i.e., learners undergoing a transitional change in their lifestyle and personal behaviour against the backdrop of the values of social justice) (Mezirow, 1997).

In the context of Natural-Science teaching, the perspective transformation that is referred to here, is the product of a Natural-Science lesson being structured in a manner that enables learners to enter a phase of critical self-reflection that allows them to question their existing assumptions and beliefs about various issues in society (Herbert, Baize-Ward & Latz, 2018).

By referring to Transformative Pedagogy in the classroom, the teacher shows an interest to teach learners the issues of social justice. This approach is followed, in order to raise awareness amongst learners about factors that negatively downplay equity and equality in society (Lynch & Curtner-Smith, 2019). Issues, such as poverty, homelessness, climate change, over-population, xenophobia, racial discrimination, gender inequality and health-care availability are some of the common issues that hamper a socially just society (Fujino et al., 2018).

Given these issues, some suggest that teaching should be organised in a manner that would promote learners' self-examination of their core values and beliefs and elicit an understanding of those, who have different core values and beliefs (Branchetti, Capone & Rossi, 2021). For Transformative Pedagogy to surface in a Natural-Science teaching setting, requires the Natural-Science teacher to be intentional in the structuring of a lesson plan that would ultimately give expression to the three core principles that underpin Transformative Pedagogy (Branchetti, Capone & Rossi, 2021).

In the first instance, the lesson plan should refer to educational activities that allow learners to be critically conscious of those social issues that affect the well-being of others (Giroux, 2018). The inclusion of such activities would engage learners in the process of self-reflection, self-enquiry and self-learning (Freire, 2005). In following this approach, learners are made aware of how their thoughts, feelings and values would affect others in society. It is important here for learners to "feel" and "know" reality as it is often perceived by the oppressed. The oppressed, which Freire (2005) refers to here, includes those individuals in society that fall victim to issues of injustice.

Kennedy (2019) believes that the ability of an individual to be critically conscious of the thoughts, feelings, and values of others, serves as a driving force towards enabling social justice and transformation within the broader society.

The principle of critical consciousness is further promoted through the inclusion of self-reflective exercises offered by the lesson plan. Blakemore and Agllias (2019) explained that the inclusion of self-reflective exercises is meaningful for triggering learners' self-reflection of existing assumptions and beliefs. In doing so, learners could consider the limitations of these assumptions and beliefs against the backdrop of a socially just society (Watts, 2021). Self-reflective exercises in the form of open and closed-ended questions, pre-tests, or surveys are valuable for clarifying learners' prior-knowledge, their existing beliefs and assumptions. The inclusion of such activities in the lesson plan would create an awareness amongst learners of the societal issues that negatively affect values, such as human equity and equality.

The existence of open dialogue between individuals in the classroom serves as the second core principle of Transformative Pedagogy (Patel, 2021). It is believed that to cultivate conscientisation amongst learners, requires them to participate in some form of human solidarity (Holmes & Tolbert, 2020). Solidarity, on the other

hand, would only emerge within a classroom context if the lesson plan permits learners to engage in educational activities that promote open dialogue. Formenti and West (2018) add that learners should be able to share their subjective experiences that are anchored in real-life events and contexts. The expectation is that using open-dialogue, learners should be able to affirm each other's views, opinions and inputs, free from any forms of intimidation and judgement. The latter would allow learners to learn from each other's experiences as a collective (Formenti & West, 2018).

For this to occur, the lesson plan should enable learners to either explain their individualised thinking in writing, or voice their individualised thinking through classroom discussions (Schuitema et al., 2018). Given this expectation, Martin (2018) suggests that the effectiveness of open dialogue in the classroom is an outcome of the trust and respect learners display towards the viewpoints and opinions of their counterparts. In making provision for open dialogue in the teaching context, the lesson plan should include educational activities that allow learners to examine social issues through acts of listening, reading, viewing, and writing. Such forms of open-dialogue would allow learners to transition their thoughts and in-class discussions to authentic practices outside the classroom (Harfitt & Chow, 2018).

It is for this reason that it is claimed that Transformative Pedagogy places a high value on learners being agents of change (Laininen, 2019). The third core-principle of Transformative Pedagogy deals with the aspect of collaborative practices. To be specific, Kaspar (2018) suggests that the lesson plan should cater for collaborative exercises that allow learners to work together as a collective in making meaning of societal issues that impact the lives of others. Johnson and Golombek (2020) add that the lesson plan should include engaging learning activities that would create conflicting viewpoints amongst learners that would ultimately challenge their current beliefs and existing assumptions.

The lesson plan should, therefore, enable learners to enter a zone of critical engagement that is underpinned by the values of trust, openness and responsibility (Johnson & Golombek, 2020). In turn, these values would foster a critical dialogue that is interpersonal, intrapersonal and discursive of nature.

Typical features of such collaborative practices should include learners' interaction with their peers in a small-group setting, learners' role-playing activities to get a certain "message" across, small-group reflective writing sessions and debating (Loh et al., 2018). Coulson et al. (2018) added that such collaborative practices should include participative engagement amongst learners in class, the greater school community, and the local community. Such participative-engagement activities are key in empowering individuals, irrespective of their status of power, level of education or influence (Giroux, 2018).

3. The Research Methodology

3.1. The Research Design

Given the aim of the study, a qualitative research methodology was employed. Qualitative research involves collecting and analysing non-numerical data, such as texts, videos, or audio recordings (Hays & McKibben, 2021). In this study, descriptive texts in graduating Natural Science pre-service teachers lesson-plan designs were analysed, in order to gain insight into the integration of the principles of Transformative Pedagogy in such plans, thereby responding to the primary research question of the study. Notably, a qualitative research methodology was useful because it allowed the researchers to collect data on all kinds of topics in a very flexible and open-ended manner.

Consequently, the application of a qualitative-research methodology aligned with the goal of this study, which was to analyse the graduating Natural Science pre-service teachers' lesson plan designs, in order to gain insight into the integration of the principles of Transformative Pedagogy.

3.2. Participants and Sampling Method

The population of the study included graduating pre-service teachers in a School of Education at a South African University. Given this population, a purposive sampling technique was employed for the study. Purposive sampling, also known as judgemental, selective, or subjective sampling (Goacher et al., 2017), is a type of non-probability sampling in which researchers choose individuals from the public to participate in the data-collection process, based on the researcher's own judgment. Klar and Leeper (2019) added that a purposive-sampling technique is the deliberate choice of an informant, due to the particular qualities that the informant possesses. For this study, the pre-service teachers enrolled in a Bachelor of Education study at a selected university in South Africa that specialised in the teaching of Natural Science in the School Education. These teachers were deliberately selected. Three of their lesson-plan designs were deliberately used as a source of the written data needed for the study to reach its goal.

3.3. The Data-Collection Method

The study utilised a documentary analysis as a data collection method. The use of documentary analysis is considered as a form of qualitative research, in which several documents are interpreted, in order to provide voice and meaning regarding a particular topic of interest (Rapley, 2018). For this study, there was a deliberate focus on the documentary evidence captured in the lesson plan designs of 3 pre-service teachers that were teaching the subject of Natural Science; since it provides sufficient documentary evidence on the pre-service teachers' ability to integrate the principles of Transformative Pedagogy into their lesson-plan designs. Given this approach, Bowen (2009) and O'Leary (2014) suggested that in seeking corroboration, researchers ought to consult any relevant documentation, such as public records, personal documents, or some form of physical evidence to capture documentary evidence that is applicable to the topic under investigation.

Other forms of data-collection methods, such as interviews and observations were not conducted. Instead, the researchers were merely interested in analysing their

lesson-plans designs to gain insights regarding the integration of the principles of Transformative Pedagogy. Although some scholars question the amount of documentary evidence that should be gathered during a documentary analysis (Groenland & Dana, 2020), other scholars insist that the quality and substance of the documentary evidence is of the utmost importance (Bowen, 2009). It is for this reason that O'Leary (2014) makes a claim for the quality of documentary evidence, rather than the quantity of documentary evidence. Given this view, the researchers opted for quality over quantity in analysing the written texts that provided written data on the lesson topics selected, the teaching-approaches followed, the teaching materials considered, the assessment methods used, and the lesson conclusions formulated in line with the principles of Transformative Pedagogy as a theoretical lens.

3.4. The Data Analysis

The researchers made use of thematic analysis to analyse the written texts that were extracted from the lesson plans of the 3 pre-service teachers. This was required to make sense of how the pre-service teachers were able to integrate the principles of Transformative Pedagogy into their lesson-plan designs. The researchers were aware that while thematic analysis was considered a flexible means to analyse the data, it could lead to discrepancies and an absence of consistency when constructing themes from the data (Elliott, 2018). To address the afore-mentioned disadvantage of thematic analysis, our intention as researchers, was to keep records of the raw data, which could assist us to systemise, relate and cross-reference the data (Watkins, 2017).

This further assisted us to create a clear audit trail of the data that were used. In addition, findings from the study were also shared with the 3 pre-service teachers, to ensure that the data presentation is credible and a trustworthy representation of the pre-service teachers' voices.

4. The Ethics

Permission for this study was granted by the Senate Research Ethics Committee at a selected South African University. Permission to use the lesson-plan designs was obtained from the 3 sampled Natural-Sciences pre-service teachers. The lesson plans for which permission had been granted were de-identified, thereby implying that the names of the Natural-Science pre-service teachers would be removed for the sake of anonymity and the pseudonyms that were indicated. The privacy, confidentiality and anonymity of the documents were acknowledged and respected. A confidentiality clause was included in all documentation, signed by the pre-service teachers, in order to ensure the confidentiality of their lesson-plan designs.

5. The Positionality of the Researchers

Positionality "reflects the position that the researcher has chosen to adopt within a given research study" (Savin-Baden & Major, 2013, p. 71). Positionality also requires the researchers to acknowledge and locate their views, values, and beliefs in relation to the research process (Goacher et al., 2017). Positionality is normally identified by locating the researcher in terms of the subject under investigation,

the research participants, and the research context. In this study the researchers only engaged with the participants to obtain their consent to use their lesson-plan designs.

Furthermore, we were aware of possible power imbalances; since this is related to the involvement of our students in this project. The students were an important aspect; since we as researchers, were offering modules that related to Natural Science education and transformative pedagogical practices in the School of Education. This awareness prompted us to be extra vigilant and cautious of power-dynamics and forms of intimidation that could have existed between us as researchers and module lecturers, as well as the pre-service teachers as participants in the study.

However, by no means did our positionality as teacher educators affect the ethical processes in this study. Ethical principles in terms of consent and confidentiality to protect the written lesson-plan data of the participants were applied. To ensure that the interpreted data correlated with the information in the lesson plans provided by the Natural Science pre-service teachers, we also allowed the three pre-service teachers to review the findings of the study.

6. Findings and Discussion

The primary research question for the study was to determine “how graduating Natural Science pre-service teachers were able to integrate the principles of Transformative Pedagogy into their lesson-plan designs.” Below is the summary of the 3 lesson-plan designs provided by the pre-service teachers. This was required to make sense of how the pre-service teachers were able to integrate the principles of Transformative Pedagogy. From these lesson plans, specific attention was given to the written text that provided the data on the lesson topics selected, the teaching-approaches followed, the teaching-materials considered, the assessment methods used, and the lesson-conclusions formulated. This was followed by an in-depth analysis, interpretation, and description of the lesson plans in line with the principles of Transformative Pedagogy.

6.1. The lesson-plan extract of Mary:

The topic that Mary selected for her Natural Science lesson was “population ecology”. Mary’s intention with the lesson was two-fold. The first lesson objective dealt with creating awareness amongst learners on ways to reduce and eliminate the adverse impact of waste material on human and animal life. Her second objective focused on creating a learning environment for learners to eagerly participate in a peer-to-peer poster presentation process that dealt with “the ways to manage waste disposal”.

As part of her introduction and teaching approach, Mary projected a photograph to the class that “depicts a recreation park close to the school that was littered with waste material”. In showing the learners this photograph, she posed the following questions, namely, “What comes to mind when you look at the picture?” “Have you seen this recreation park before?” “If so, how does this recreation park make you feel when you walk past it on your way to school?” and “How do you think does the community feel that are staying close to this recreation park?” After posing these questions, Mary then entered a whole-class discussion with her learners where they discussed topics, such as “waste

disposal” and “waste management”. When participating in the whole-class discussion, Mary wanted her learners to obtain a better understanding of what was meant by “waste disposal” and “waste management”, as concepts relevant to the Natural Science school syllabus. To facilitate the discussion and further enable the learning progress, Mary shared printouts of visual examples of “waste disposal” and “waste management” with her learners.

Following the whole-class discussion, she then divided the class into groups of four; and she instructed each group to develop a creative poster that “dealt with ways to manage waste disposal”. In concluding the lesson, Mary shared a homework activity that required the learners to survey all the forms of waste material generated in their homes, and to then report their findings to their fellow classmates the following day.

Mary’s lesson plan made several references to the principles of Transformative Pedagogy. To be specific, the principle of critical consciousness came to the fore with her intention to “make learners aware of the negative impact of waste pollution on the health of local citizens from the surrounding community”. More evidence of the principle of critical consciousness surfaced, when Mary posed open-ended questions, such as “How does the recreation park make you feel, when you walk past it on your way to school?” and “How do you think the locals feel that are staying close to the park?”

In addition to the learners being made critically consciousness of the issue of waste management, Mary’s lesson also showed signs of collaborative practices. For example, her lesson expects from learners to “eagerly participate in the development of posters that suggest ways to manage waste disposal”. This activity enabled the learners to work together as a collective to engender meaning of societal issues that impact the lives of others (Kaspar, 2018).

This form of critical engagement fosters values, such as trust, respect, openness and responsibility amongst the learners (Johnson & Golombek, 2020).

Another striking feature of the lesson, is Mary’s use of critical open-ended questions. Blakemore and Agllias (2019) reminded us of the importance of using open-ended questions to clarify learners’ prior knowledge, existing beliefs and assumptions. The questions that Mary posed, such as “What comes to mind when you look at the picture?” and “Have you seen this recreation park before?” prompt learners to express their individualised thinking in the form of a classroom discussion (Watts, 2021); thereby allowing learners’ voices to be amplified in such a manner that is the key towards enabling learners to acknowledge each other’s diverse viewpoints and opinions.

This approach is essential in eliciting trust and respect among learners in a learning environment (Harfitt & Chow, 2018).

6.2. The lesson-plan extract of Katlego:

The topic that Katlego selected for his Natural Science lesson dealt with “food security and hunger relief in a South African context”. Like Mary’s lesson, Katlego also made provision for two lesson objectives. In the first instance, Katlego hoped to “create an awareness

amongst his learners on how food insecurity and hunger affect the daily lives of others." His second lesson objective centred around "enabling learners to create a vegetable garden in the school, as a means to sustain food security." As part of his lesson introduction and teaching approach, John played a video that "shared the faces and stories of people who struggle to put food on their families' tables."

After playing this video, Katlego then asked the learners questions, such as "How did this video make you feel?" and "do you think that this is the reality? Following this brief classroom discussion, Katlego then decided to read "section 27 (1)(b)" from the "South African Constitution," which declares that "all the citizens of South Africa have the right to have access to sufficient food and basic nutrition;" and he asked learners to brain-storm strategies to "eradicate hunger in the local community."

Given this task, the learners were vocal in sharing potential strategies that could potentially eradicate hunger amongst locals in the community. Finally, the concluding stage of his lesson required learners to develop an action plan on how a vegetable garden can be developed on the local school premises. With this task in mind, Katlego assigned well-prescribed roles to various groups in the classroom that would breathe life into the task. Group "Nonyane" was tasked to measure and calculate the exact space for the vegetable garden on the school premises.

Group "Tlou" was tasked to carefully consider which types of vegetables to plant, given the climatic conditions of the local region. Group "Letlotse" had to investigate whether the soil was fertile enough for the vegetables to grow. Finally, group "Sefêlaphiri" penned the learner-roles and responsibilities in terms of sustaining the vegetable garden.

The lesson presentation provided by Katlego also shows signs of Transformative Pedagogy. To be specific, the principle of critical consciousness reflects in Katlego's lesson in multiple instances. To be specific, the questions that he poses to his learners, namely "how did this video make you feel?" and "do you think that this is the reality?" challenges the learners' beliefs and views on the urgency to act on food insecurity, as a social issue. In addition, Katlego also expects his learners to engage in an episode of self-reflection, in order to come to grips with the reality of food insecurity in the local region in which they find themselves.

Katlego's lesson further touches base on the principle of open dialogue in the classroom context. Particularly, the teaching activity that enables learners to brainstorm and share strategies to "eradicate hunger in the local community." This aligns well with the principle of open dialogue. In other words, learners can voice their individualised thinking in a conducive space, free from forms of intimidation and judgement (Schuitema et al., 2018). In following this approach, learners are positioned as "change agents," which are capable of tackling real-life societal challenges." (Laininen, 2019)

Finally, Katlego's lesson further caters for the principle of collaborative practices. This is evident when Katlego tasks his learners to collectively brainstorm and pen strategies to potentially eradicate "food insecurity" and "hunger" in the local community. Furthermore, additional classroom activities that relate to collaborative practices surface, when Katlego instructs his learners to devise an

action plan on how to create a vegetable garden in the school. With this activity in mind, Katlego is hopeful that his learners will realise that although food insecurity is a real issue in the community, learners themselves can act as “problem-solvers” and “change-agents” that are capable of addressing the issue.

6.3. The Lesson-plan extract of Maru:

The over-arching topic that Maru selected for her Natural Science lesson dealt with the female reproductive system, as a “driver” to gender inequality and gender violence. The aim of Maru’s lesson was to make learners aware of the conations between the female reproductive system and female genital mutilation, as a form of gender-based violence. For learners to realise this aim, Maru proposed four lesson objectives. The first lesson objective required learners to become familiar with the different parts of the female reproductive system, as prescribed in the Natural Science school syllabus. With the learners’ fundamental knowledge of the female reproductive system in place, Maru suggested a second lesson objective, that required the learners to take note of the procedures involved in the process of female genital mutilation. Maru’s 3rd lesson objective, aimed to make learners aware of the health complications that were related to the practice of female genital mutilation. Finally, her 4th lesson objective attempted to create an awareness amongst learners on how the practice of female genital mutilation violated the rights of young African females, which ultimately resulted in gender inequality.

As part of her lesson introduction and teaching approach, Maru adopted a teacher-centred approach to explain the anatomy of the female reproductive system to her learners. She then posed a couple of closed-ended questions to the learners, in order to test their factual knowledge of the topic. Moving on towards the main section of her lesson, she provided each of the learners with a print-out of a newspaper article entitled: “Who will end the agony of girls undergoing female genital mutilation”. She then instructed her learners to read the article; and she insisted that the learners engage in a self-reflective writing exercise that would allow them to share their views on the topic of female-genital mutilation. Finally, the concluding stage of the lesson was dedicated to learners sharing their views on how awareness could be raised about female genital mutilation as a human-rights violation act.

The lesson plan provided by Maru serves as a prime example of teaching for equity and equality. Her lesson is structured in a manner that made explicit references to the principles of “critical consciousness” and “open-dialogue”. A closer look at her topic reveals that she intends to make learners conscious of how young African females are exposed to “gender inequalities”, “gender-based violence” and the “violation of human rights” through practices that related to the “female-genital mutilation process.”

Throughout her lesson, a multitude of references were made to educational activities that requires learners to be “critically conscious on how the social issue of “female-genital mutilation” affects the physical, social and emotional well-being of young African women” (Kennedy, 2019). One such activity, is Maru’s use of a self-reflective exercise that prompts learners to “feel” and “know” reality (inter alia female-genital mutilation, as a form of gender-violence and abuse), as it is often perceived by the oppressed (inter alia, young African women enduring such an extreme form of gender violation) (Freire, 2005).

Maru's inclusion of self-reflexive exercises in her lesson enables learners to engage in acts of self-reflection, self-enquiry and self-learning (Freire, 2005). Maru's lesson further caters for the principle of open dialogue, as another prominent principle of Transformative Pedagogy. For example, the "self-reflective reading activity" with which she provided learners, not only allowed the learners to reflect on their thoughts and beliefs about the practice of female genital mutilation: but it further enabled learners to share their subjective viewpoints on the topic with their fellow peers.

The teaching approach followed by Maru aligns well with the view of Martin (2018), when it is suggested that the effectiveness of open dialogue in the classroom context is an outcome of the trust and respect that each of the learners displays towards other's viewpoints and opinions. Maru's lesson referred to key features of open dialogue; since the learners were able to examine social issues through listening, reading, viewing, and writing (Formenti & West, 2018). This approach is often referred to as a form of human solidarity (Patel, 2021). Holmes and Tolbert (2020) claim that human solidarity will only emerge within a classroom context if the lesson plan permits learners to engage in educational activities that promote open dialogue amongst the learners, as witnessed in Maru's teaching approach.

7. The Conclusion and Some Recommendations

The purpose of this study was to analyse how graduating pre-service teachers were able to integrate the principles of Transformative Pedagogy in their Natural Science lesson-plan designs. Conducting this study was important: since the expectation at the School of Education is that pre-service teachers should be able to demonstrate an in-depth understanding of Transformative Pedagogy, which is a form of pedagogy that combines the aspects of social constructivism and critical theory (Mezirow, 1997).

The use of Transformative Pedagogy comes in handy when an educator is interested in teaching for equity and equality (Tinning, 2017). However, given this expectation, little to no effort had been made by us, as teacher educators in the School of Education and researchers of this study, to uncover how our Natural Science pre-service teachers were able to integrate the principles of Transformative Pedagogy into their lesson-plan designs. This argument motivated us to conduct this study.

Based on the findings of the study, the lesson-plan designs of three pre-service teachers demonstrate an integration of the principles of Transformative Pedagogy, namely the "prompting of learners' critical consciousness about social issues", "the existence of open-dialogue amongst learners" and "learners' engagement in educational collaborative practices". The three principles of Transformative Pedagogy were thoughtfully considered by the 3 pre-service teachers: and these principles were integrated into their "lesson topics selected", "teaching approaches followed", "teaching materials considered", "assessment methods used" and "lesson conclusions formulated". Interestingly, all three

lesson-plan designs were structured in a manner that provoked learners' critical consciousness about social issues that centred around topics, such as "food security and hunger relief in a South African context - Katlego", "impact of waste material on human and animal life - Mary" and "female-genital mutilation, as a form of gender-based violence - Maru."

The principle of critical consciousness, that is informed by the practices of self-reflection, self-enquiry and self-learning (Freire, 2005), formed the backbone of the majority of lesson objectives structured in the 3 lesson-plan designs. Consequently, the pre-service teachers were able to develop lesson objectives that required "learners to have an awareness on the health complications related to the practice of female-genital mutilation - Maru." Another lesson objective informed by the principle of critical consciousness was for "learners to realise how the practice of female-genital mutilation serves as a driver of gender inequality and violence - Maru."

The nature of the lesson objectives further promoted an educational experience that gave expression to "collaborative practices" and "open-dialogue" as the two other principles of Transformative Pedagogy. For example, a closer look at the introduction planned and the teaching strategies followed in the lesson-plan designs provided evidence of educational activities that required learners to engage in collaborative exercises where they work together as a collective, in order to make meaning of societal issues that impact on the lives of others.

In particular, Katlego's lesson expected his learners to "develop an action plan on how a vegetable garden can be developed in the local school premises". Another interesting example was when Mary requested her learners to form groups of four and develop a creative poster that dealt with ways to manage waste disposal." These different types of collaborative practices followed further prompted learners to engage in the practices of open dialogue.

Open dialogue, as a third principle of Transformative Pedagogy, caters for educational practices that empower learners to affirm each other's views, opinions and inputs in a conducive learning environment that is free from forms of intimidation and judgment (Formenti & West, 2018). From the lesson-plan extracts, open dialogue was prominent in all 3 lesson plans. For example, open-ended questions posed, such as "What comes to mind when you look at the picture?:" and "How does this recreation park make you feel when you walk past it on your way to school?:"

Mary" not only allowed for learner-discussion: but she also catered for learners' self-reflection. More evidence of open-dialogue and learner self-reflection could be found in Katlego's lesson plan, when he posed open-ended questions, such as "how did this video make you feel?" and "do you think that this is the reality?"

In this study, we make the claim that the 3 pre-service teachers were indeed strategic in planning their lessons, in order to cater for didactical conditions that were transformative in nature. Drawing upon Mezirow's (1997) psychological,

convictional, and behavioural dimensions, we were confident to declare that the pre-service teachers were capable in structuring Natural Science lessons that initiated educational experiences, which empowered their learners to transform how they perceive “the self” (psychological dimension). We are further of the view, that the pre-service teachers could structure lessons that would enable learners to “critically reflect on their existing beliefs and values” (convictional dimension).

Finally, we concur that the pre-service teachers were successful in structuring lesson plans that would enable learners to undergo a “transitional change in their lifestyle and personal behaviour” against the backdrop of the norms and values of a socially just society.

The limited sample size might potentially serve as a limitation of the study. Future research should consider a larger sample of lesson-plan designs. Going forward, this study holds a series of implications for future research in the field of pre-service teacher development, especially in the field of science education. Given the ideals of Transformative Pedagogy, future research could focus on the capability of pre-service teachers infusing the principles of Transformative Pedagogy in other science-related school subjects, such as Physical science and Chemistry teaching. Future research could also perhaps explore how pre-service teachers experience the integration of Transformative Pedagogy into their lessons.

8. References

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