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RESEARCH ARTICLE

Challenges Impeding Technology Education Teachers in Delivering Lessons to Raise Students' Awareness About Littering

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Background/purpose – Technology education (TE) offers hands-on activities through a design process to be an environmentally-oriented subject. TE can be used to reduce littering, an environmental problem that also has health implications for modern-day society. This research study sought to explore the challenges that impede TE teachers in delivering lessons to raise students' awareness of littering through the application of the participatory paradigm.

Materials/methods – TE teachers of Grade 8 students were selected using purposive sampling in this qualitative participatory action research (PAR) study. The use of PAR was chosen in order to develop relevant action research-based methods of intervention that can be implemented to address gaps in the literature. Chaos theory was used to ground the study. Interviews were used to generate data from the study participants, which were then analyzed using the content/textual analysis method.

Results – The study identified issues, challenges, and obstacles that impede TE teachers from delivering lessons that raise students' awareness about littering. Lack of understanding environmental education and subject relevancy were found to be some of the major challenges facing TE teachers in conscientizing students about littering.

Conclusion – The author concludes that TE teachers need to be equipped with environmental pedagogies through inservice training in order that they can incorporate littering issues into their lessons.

Keywords – chaos theory, environmental education, littering, problems, technology education

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1. INTRODUCTION

Reforms in the education system of South Africa seem to suggest that teachers struggle to tackle the subject of littering in schools, as well as beyond the boundaries of the schoolyard. It was pointed out many years ago that South Africa has a culture of littering (Little, 1998). Ten years later, Mambinja (2008) observed that littering was still on the rise in the country. Subsequently, Nkambwe and Essilfie (2012), continued to observe that haphazard littering was still rampant in schools. These studies were conducted during curriculum reviews as outlined in Table 1, indicating the persistence of littering in South Africa.

Even before the Coronavirus pandemic (COVID-19), littering in South Africa was considered a major issue (Ryan et al., 2021). However, the mandated use of surgical face masks in interior spaces to prevent COVID-19 transmission resulted in a rise in municipal waste from discarded single-use masks and other personal protective equipment (PPE) such as latex gloves (Spennemann, 2021). This study intends to respond to the following research question: What challenges impede technology education teachers in delivering lessons to raise students' awareness of littering? The study's literature review is discussed in the following section.

2. LITERATURE REVIEW

As stated in the first paragraph of the introduction, since the dawn of South Africa's democracy in 1994, curriculum reforms in the country have faced considerable problems (Mamabolo, 2021; Sebaeng, 2022). Curriculum reviews within the South African education system have resulted in various challenges to teachers in the integration of environmental education (EE) and education for sustainable development (ESD) in subject areas such as technology education (TE). Thus, over the years, studies have been conducted to explore the challenges that teachers encounter. Such scholars include Malhotra and Upadhyay (2021), whose research looked at how sustainability is taught both theoretically and practically in TE in Ireland. Similarly, South African scholars Ruthanam et al. (2021) investigated the choices of teaching strategies for EE that South African teachers made within the primary school context, whilst Tsotetsi (2021) examined how South African teachers in selected primary schools implemented EE. However, these studies did not specifically examine the challenges that eighth-grade TE teachers encountered in schools, hence, the current study aims to address this gap in the literature.

Moreover, Ho et al. (2022) investigated situations and obstacles in EE within preschool teacher training programs in Vietnam. Cyprian's (2022) research sought to analyze EE awareness and implementation in Tanzanian secondary schools. Moeletsi (2022) conducted research in South Africa that focused on the constraints that TE teachers experience and that impede effective TE teaching. The goal of a study by Akbar et al. (2023) was to investigate environmental activities organized within Pakistan's high schools. Wang et al. (2023) attempted to clarify teachers' challenges in TE while including ESD educational activities within the curriculum in Japanese public junior high schools. However, these studies did not attempt to investigate challenges impeding grade 8 TE teachers' attempts to raise students' awareness of litter and littering.

The aforementioned scholars utilized common data collection methods or similar research approaches to generate data from their study participants. Nevertheless, little research has been undertaken using the action research approach in EE and TE to examine challenges impeding TE teachers to raise students' awareness of littering. Furthermore, chaos

theory was not applied in the data analysis of any of the reviewed studies. Only one had used participatory action research, but had not attempted to ascertain what challenges were encountered by TE teachers at the Grade 8 level. Therefore, a paucity of research exists that has investigated the intersection of the EE and TE disciplines; hence, the current research distinguishes it from other studies in this area. Furthermore, most studies on EE and TE have focused on a single topic and investigate a single issue, whilst the current study aims to address this gap in the literature by identifying the challenges that TE teachers experience in their schools through the application of chaos theory.

Theoretical Framework

Prigogine and Stengers (1984) theoretically synthesized chaos theory, which was then popularized by Gleick (1987). According to Trygestad (1997), the significance of chaos theory lies in its capacity to explain the behavior of various systems. As a result, it is possible to apply some of the theory's concepts such as systems, fractals, initial effects, and bifurcations to classroom instruction in which teachers engage with students. In order to examine the South African educational system, the current study uses an action research approach to evaluate the difficulties that TE teachers have faced in attempting to incorporate litter issues into their lessons with the aim of raising students' awareness of littering.

Chaos Theory – Its Value and Application

The rest of the universe is interconnected with education, and as a result, it is completely subject to the chaos that exists in reality (Fahim & Talabari, 2014). The closing of teacher training colleges as part of the restructuring of South Africa's education system and other changes to the curricula are just a few of the education reforms that resulted in chaos in the classrooms. As a result, a growing gap between teaching and learning about continuous environmental issues began to exist. Lessons can be drawn about the influence of both internal and external factors on school operations, as well as the necessity for professional development and novel cooperative strategies as a means to control the chaos and create learning communities (Snyder et al., 1995).

Participatory Paradigms

By reflecting on the challenges that South African education has encountered and through engagement with TE teachers, the current study's author assumed that participants in the research would reveal what types of challenges teachers encountered in attempting to raise their students' awareness of litter issues when delivering lessons. As such, the application of chaos theory was seen as having the potential to reveal the challenges that TE teachers faced.

3. METHODOLOGY

This qualitative participatory action research is situated within the integration of EE in TE and explores the challenges that impede TE teachers in influencing students' littering behavior. Participatory action research was applied in the study to explore challenges that impede TE teachers in delivering lessons that raise students' awareness of the issues of litter and littering. The use of participatory action research was chosen in order to develop relevant action research-based methods of intervention that could be implemented to address certain gaps.

Participants

The author selected elements from the population that were deemed representative or informative about the topic of interest through purposeful/purposive sampling (McMillan & Schumacher, 2010). In this case, the author used purposive sampling to select eighth-grade TE teachers for a number of reasons. First, the sample for the current study needs to be manageable. Second, TE can offer hands-on activities through a design process and is considered an environmentally-oriented subject. Third, TE teachers interact with eighth-grade students for the first time in secondary school. As they move through the "General Education and Training" band level to "Further education and training," TE will play a crucial role when students choose relevant subjects for their career path such as electrical engineering, environmental management sciences and so forth.

Procedures

The author first visited candidate schools in order to seek permission from their administration to conduct the study. Further, the author met with prospective study participants so as to explain the purpose of the research. The participants were advised that they were welcome to engage voluntarily in the study, but that they would not be compensated for their involvement. Participant consent forms were then signed in order that participants could be part of the study. An Ethics Clearance Certificate (number 2020/06/48502928) was issued so as to grant the author permission to conduct the study. Ethical dimensions were followed which included gaining permission to conduct the study, getting informed consent from all participants, as well as ethical considerations based on access and acceptance, data privacy, anonymity, confidentiality, and safety. The author then took 6 months to collect data in the field.

Instrument

This study used interviews as the method to generate data from the study's participants. The interview questions asked of the participants were first subjected to a piloting process. This was applied in order to avoid issues during data collection regarding important questions the participants may have had about the research instrument, since this was avoidable through pilot testing (Gumbo, 2014). Pilot studies are also considered useful for the framing of research and data collection questions, gathering background information, refining a research approach, or customizing effective research instruments (Nunes et al., 2010). The author used semi-structured interviews in the current study in order to explore the challenges that TE teachers encounter. In-depth interviewing is a qualitative data collection method in which researchers ask participants questions to learn more about their perspectives, opinions, and beliefs about the phenomenon under study (Strydom & Bezuidenhout, 2018).

Data Analysis

In qualitative research, several data analysis methods can be used to analyze the collected data. Having said that, the current study made use of content/textual analysis as a method of data analysis that gives a systematic and objective way to reach correct inferences from verbal, visual, or written data to characterize and quantify certain events (Wolhuter & Seroto, 2020). According to Bezuidenhout and Cronje (2018), content analysis is used to both generate and analyze data. This assisted the author in identifying textual keys that helped in the understanding of the issue and in the interpretation of the collected data.

The author used an interpretative paradigm to undertake a qualitative content analysis in order to provide a detailed account of the social reality (Strydom & Bezuidenhout, 2018). In analyzing the data, in the first step the author used a digital audio recorder to record the interviews held with TE teachers. In the second step, interviews captured as digital recordings were then transcribed using Microsoft Word. After the transcription had been completed and codes were assigned to the data, the data were examined in a third stage to categorize emerging themes. This was conducted in line with the research question of the study. A Microsoft Excel spreadsheet was then used to present the data in tabular format. A verbatim coding process was used to capture the essence of the participant TE teachers' responses.

Purpose of the Study

The study aimed to explore challenges that impede TE teachers in delivering lessons aimed at raising students' awareness about litter and of littering.

Problem Statement

Ogunniyi (2005) reported that,

> *…before the curriculum reform era, Science and Technology curricula in most African countries were in the form of syllabi set out primarily for examination purposes. The Science and Technology curricula were left to grow on their own and soon became cluttered with materials that presented an inadequate view of Science and Technology.* (p. 126)

It should be remembered that, prior to South Africa's 1994 independence, education was primarily limited to the provision of primary education, with science playing only a minor role (Jacobs, 2015). TE falls under science education, and students thus had the opportunity to become technologically literate with the aim to solve increasing environmental issues through technological means. Since independence, the South African education system has undergone four major revisions aimed at alleviating political injustice and inequality created by the former apartheid regime's effect over the country's education system.

TE was introduced into South African curricula over two decades ago (Ankiewicz, 2021), with a transformation triggered following the democratic elections of 1994. Reviews were undertaken to ensure that curricula going forwards was relevant to all South African citizens, irrespective of their color, creed, or race. This period of curriculum transformation included the accommodation of EE and the alignment of South African curricula to meet global developments. Table 1 highlights the curriculum reviews over the years for both primary and secondary school educations. These reforms were subsequently implemented within both private and government (state) schools.

Table 1. Curriculum Reviews in South Africa

CURRICULUM REFORMS	IMPLEMENTED
Curriculum 2005 (C2005)	1998
Revised National Curriculum Statement (RNCS)	2002
National Curriculum Statement (NCS)	2006
Curriculum and Assessment Policy Statements (CAPS)	2012

Meeran and Amin (2021) claimed that changes in South Africa's curricula have had a significant effect on the country's body of teachers, since they were required to change the

entire way in which they had been teaching. This meant that teachers were required to undertake a paradigm shift from a teacher-centered to a student-centered approach, and to make use of the latest technologies in the classroom such as smartboards and tablet personal computers. Despite the breadth of these changes, the integration of EE into school subject areas formed part of the ongoing school program in order to impart environmental knowledge and skills to South Africa's student population.

TE teachers are tasked with giving all due consideration to teaching TE with EE, as highlighted in the TE policy document. The policy stressed that technology can provide students with opportunities to learn how to deal with inclusiveness, human rights, as well as social and environmental problems in their tasks (Department of Basic Education, Republic of South Africa, 2011, p. 9). The current study considers the intersection of two disciplines, EE and TE, with an attempt to explore impediments that may challenge eighth-grade TE teachers to deliver lessons that aim to raise students' awareness about littering in the context of South African schools.

Research Question

What challenges impede technology education teachers in delivering lessons to raise students' awareness of littering?

4. RESULTS

Several challenges that can hinder teaching and learning concerning littering in South African schools were discovered and categorized as conceptual, logistical, educational, and attitudinal barriers (Ham & Sewing, 1988).

Conceptual Barriers

A lack of understanding EE and its subject relevancy were identified as some of the major challenges impeding TE teachers in conscientizing students about littering. This lack of understanding of EE was evident when TE teachers referred to EE as an "environmental study." For instance, one teacher indicated that, "*Last year the topics that required me to integrate environmental studies were only done during term three.*" Consequently, TE teachers struggled to integrate EE matters and raise students' awareness about littering.

TE teachers claimed that the topic of littering was not included in the curriculum. One TE teacher said that, "*For now, there is not much except when they just pick up paper and plastic and throw them into the bin.*" Be that it may, the integration of EE takes in littering in all TE themes, and failure to identify these themes can result in chaos in the teaching and learning process. Littering is taught by way of the integration of subject matter. TE content encompasses subject topics of technology, society and environment, processing, systems and control, and structures, and these topics offer certain opportunities to integrate EE into the lessons. However, the TE teachers were not found to be that well informed, and generally misunderstood how environmental issues such as littering could be taught in many of the TE topics. This misconception was exacerbated by the inadequacy of workshops, leading to the non-integration of EE content and a subsequent lack of EE qualifications. On this, one of the TE teachers stated the following:

> *Okay, I would say when they were presented at the workshop, it was up to the teacher to identify or underline content focusing on EE and indigenous knowledge. But, the workshop was all about how we covered the syllabus and finish the curriculum. We focused mostly on covering the curriculum, discussing about scheduled tasks (start and*

> *end date), marks and marking sheets. Unless someone said it was their first time teaching the subject and requested additional training, it would not have been known. But we have never unpacked EE or indigenous knowledge thoroughly. Facilitators just came prepared to tell us which topics needed to be covered during the first or whatever term.*

It was also found that many of the TE teachers had not specialized in teaching TE as a subject. One teacher commented that, *"It is not easy to teach technology because I do not have a technical background wa bona* [you see]*."* Another teacher indicated that, *"I was told to teach technology since I teach electrical technology."* Many schools did not have their own qualified technology teacher; instead, teachers of other subject areas were recruited or tasked with teaching technology (Ankiewicz, 2021; Moeletsi, 2022), which added to their challenges of teaching TE and EE content in their lessons.

With little experience or specialization, there were certain misconceptions in implementing the revised curricula. For instance, waste materials were not utilized when teaching students about littering, but were incorporated in the practical assessment task (PAT). One of the TE teachers said that:

> *Like, for example, in term one we had a mini-PAT where eighth-graders were supposed to make a crane crasher, whilst ninth-graders were tasked with building a bridge. In this way, we advised the students to go out into the environment or within their immediate surroundings to collect recyclable materials; materials that were just lying around that they could subsequently use in their class projects*.

This could imply that if students did not complete the task, then the TE teachers would not have used such waste materials in the classroom. The PAT does not form part of the lesson plan but is assigned as a marked formal task. Tsotetsi (2021) observed that waste and recyclable materials are generally not employed within classroom activities since TE teachers lack adequate pedagogical knowledge and skills to deliver EE content to students. This inadequacy contributed to what the TE teachers perceived as EE lacking subject relevancy; meaning that failure to integrate EE indicated that TE teachers were unable to see the relevance of EE in TE. Perhaps not all teachers perceived that schools were engaged in a process of positive change (Snyder et al., 1995).

Related to the issue of littering, the TE teachers that were interviewed believed that administering the PAT equated to teaching students about littering, and that since environmental issues such as littering were not incorporated within TE topics, there was inadequate assessment of environmental issues in classwork, homework, and in tests. In their respective studies, both Fru and Ndaba (2023) and Ruthanam et al. (2021) reported that a number of teachers just concentrated on getting their students to pass examinations, which would influence TE teachers to ignore or only partially focus on environmental content, seeing curriculum coverage as their most vital task, and thereby not considering the development of environmental awareness in students.

Logistical Barriers

The TE teachers indicated that due to a lack of time, they had not become involved in environmental activities at their school; meaning that they had not engaged students in environmental activities such as the celebration of Arbor Day (involves tree planting) or any of the other environmental days.

> *No I can't because I arrive at school around 7:30 and knock off at 14:30. Anything that has to do with me, it has to go through the School Management Team (SMT) and School Governing Body (SGB), and this process is messing things up*.

In contrast to the current study, Akbar et al. (2023) and Cyprian (2022) revealed that some schools never observed environmental days among their activities. In the current research, some of the TE teachers claimed that protocol served as an obstacle for them to engage in school activities. For instance, the TE teachers believed that the organization of marking environmental days should go through the SMT and the district office. Whilst the TE teachers expressed an awareness of the need for curriculum coverage and were often challenged to complete the syllabus, they admitted to not having time to participate in environmental activities.

The author posits that a lack of environmental policy and guidelines in schools could be contributing to a general lack of environmental awareness, which in turn results in persistent littering in and around schools. The absence of environmental activities in schools may be contributory to students' lack of environmental awareness. This is a major concern since school-aged students need to be equipped with the relevant knowledge, understanding, skills, and motivation to make responsible decisions in their own relationship with the environment and within their respective communities. One of the TE teachers indicated that,

> *Umm, I think it must be in the school policy because even if I want to do it, but it is not in the management plan/calendar of the school, it's difficult for teachers and students to celebrate Arbor Days.*

Lack of finances and funding, coupled with overcrowding, also serve as obstacles for TE teachers to incorporate the teaching of environmental content effectively. Teaching students *about, in,* and *for* the environment needs to include learning both indoors and outdoors. Field trips can enable students and teachers to explore theoretical learning in the real world through practice; however, due to a lack of finances, TE teachers are rarely able to plan any sort of environmental field trips (Ho et al. 2022; Moeletsi, 2022; Ruthanam et al., 2021). Lack of support from schools as well as the South African Government's Department of Basic Education also contributes to the reality of the lack of field trips and resources. In order to address in some way, the lack of funding, teachers could task students with creating artistic products which may then be sold in the community. Furthermore, schools generate waste on a daily basis, but some of that could be recycled so as to fund field trips and to address certain resource shortages. As advocated by living educational paradigm for teachers to reflect on their practices.

> *We are not getting support because instead of showing students projects we just explain whatever it is verbally, there is nothing they can actually see or feel. We do not get materials, for instance, even if it's not something to do with the environment; electricity, for instance, we'll only talk about it and not show anything concrete on the subject. We always explain things to students and we explain projects instead of showing them what an LED or lightbulb is, as we don't have them for students to see. Our practical work is done orally, and that is the first thing that makes our work difficult.*

The TE teachers' workload and administrative responsibilities affect their teaching. They are also required to teach other subjects and often teach more than one grade, which means their focus is not entirely on the teaching of TE. It is possible that this workload-based

issue has contributed to TE teachers not having TE files with all the necessary documents, since for the majority of TE teachers the subject is not actually their primary/qualified discipline. Therefore, balancing subject content can be problematic for some TE teachers, leaving them struggling to integrate EE content in TE.

Educational Barriers

One major barrier in this category is language.

> *But in writing it has to do with the language and it has to do with the answer in relation to the question – that's how you assess if the student has answered the question with understanding, or whether they just gave an answer without understanding*.

TE teachers find that they need to use code-switching in order to accommodate their students' understanding. The majority of students in the participating schools spoke isiZulu as their native language. However, in South African schools, from Grade 4 English is the official "language of learning and teaching" (LoLT), which could present a problem to certain students if their English language proficiency is not sufficiently well developed. In such cases, teachers will often code-switch, but it is felt that the use of English in schools where the majority of students speak indigenous languages can result in undervaluing the mother tongue of the student body (Ogunniyi, 2005).

The lack of an environmental policy implemented in schools may be as a result of there being no EE coordinators to support teachers in schools. Clearly, if the support is lacking, environmental issues, which affect all teachers, staff, and the wider community, are not being addressed. The author suggests that the lack of EE coordinators in schools negatively impacts upon implementation since there is no one monitoring EE activities, and also nobody ensuring that teachers' needs are also being met. This means, for example, that TE teachers without the support of an environmental coordinator and appropriate environmental policies cannot ensure that students' knowledge about litter issues translates into actions by students in the environment. This could partly be due to TE teachers lacking the requisite knowledge or learning approach, and thereby struggling to link TE with EE content as lessons focus mostly on indoor-based learning with minimal environmental content.

Continuous professional development for inservice teachers is vital in order to ensure that teachers keep abreast with educational innovations and to enhance their pedagogical knowhow. The workshops that TE teachers attend unfortunately do not equip them with adequate environmental knowledge, but rather focus on amendments to curriculum policy, the annual teaching plan, and assessment. The inadequacy or lack of training is perhaps contributed to by workshop facilitators' lack of EE knowledge and lack of EE qualifications as some of the TE teachers claimed. Preservice teacher training needs to focus on enabling students to develop a set of values for education that will enable them to be effective in their future classrooms (Pienaar & Lombard, 2010). The author posits that a number of teachers lack EE qualifications. In addition, only four out of 26 public universities in South Africa offer EE qualifications, meaning that very few TE specialist teachers are actually being appropriately trained. If facilitators had EE as a specialist qualification, they would be better able to support TE teachers in their teaching, and to ensure that EE is better integrated with the topics taught to today's students.

Attitudinal Barriers

In many schools, TE is taken somewhat for granted as a subject and often considered less important than other more mainstream subjects. This, in turn, could negatively affect attitudes to both the subject itself and the teachers about teaching it, especially if they have been allocated to teach the subject simply because there was nobody else available. In such cases, the teachers need to rely upon help from specialist facilitators and their SMT, especially where qualified TE teachers are unavailable (Ankiewicz, 2021; Moeletsi, 2022). In addition, in many schools, the departmental heads responsible for leading TE instruction lack any qualifications in TE themselves and thus show a lack of interest and commitment to the subject. This translates into an attitudinal barrier towards TE as teachers are then additionally challenged to incorporate environmental content in certain TE topics.

> *According to me, since I started teaching technology, I think…I don't know…let me say since I started teaching technology from where I am standing, it is a subject that is not taken seriously like the others. It is an additional subject that students must take for the sake of it because it is just in Grade 8 and 9. I do not know but it is not taken seriously, just taken as an additional subject. I do not want to speak on behalf of the school, but from where I am standing it is just an additional subject. And even with people you think can help you, if you ask too much it feels like…I don't know how to put it, like you want to ask them how they teach, and they don't understand that you just want a bit of help. I do not know if you get me. And this influences students to feel it is just a subject for them to go to the next grade. We do not have the right attitude toward the subject. Even if you try to show students the link of technology with other subjects like social sciences, natural sciences, and economic management sciences. By the time you identify the problem is social. Solutions might include science, like looking at types of materials and math, as you need to calculate whatever you see. We do not have a positive attitude; I think that is why teachers end up like that. We are like, umm, let me do it so that they pass to another grade.*

Technology should ideally be taught in a well-equipped and well-resourced laboratory. The lack of laboratories in the sample schools is seen as a further indication that TE, as a subject, is not well coordinated, nor afforded the priority it deserves in South African schools. The interviewed TE teachers attested that; "*I use the normal classroom to teach Technology," "I teach technology in a normal classroom," and "We don't have labs, TE also needs a lab like any other subjects such as the natural sciences, but we don't have one so we teach the subject in the normal classroom*." Negative attitudes toward TE implementation in schools are likely to arise due to a lack of infrastructure and insufficient relevant resources (Ankiewicz, 2021; Moeletsi, 2022; Wang et al., 2023). It is for this reason that students take TE as a subject in South Africa simply for the sake of passing Grades 8 and 9 in order to exit the General Education and Training (GET) band. The lack of equipment and resources in laboratories contributes to the lack of teaching *about, in,* and *for* the environment, which is then exacerbated by TE teachers' pedagogical styles which can effect developing students' awareness about environmental issues such as littering.

5. DISCUSSION

In this study, the author discovered that TE teachers' understanding of EE is lacking and that it could become a barrier to the successful integration of EE in TE lessons. Although some of the TE teachers' responses differed, their general understanding of EE was inadequate. Some of

the interviewed TE teachers thought EE to be environmental studies, which is detrimental to their ability to teach the subject and thereby their approach. Some of the factors led to chaos in their teaching and their students' learning. In a chaotic setting, it can be challenging to see the relationship between teaching and learning (Fahim & Talabari, 2014). For instance, the TE teachers had a degree of understanding of the concept of littering and an awareness of the effect that littering has on the environment, as they were aware that litter causes harm to both the human and animal population, but that awareness was not being transferred to their students in terms of their attitudes and behavior towards the environment.

Despite the TE teachers having claimed to know that the documented TE policy in South Africa encourages them to teach students about the environment, their assertion was not supported by the tasks/activities that they were assigning to their students in the classroom, nor in their methodological approach, which tended to promote a more teacher-centric approach. In addition, it was established that most of the TE teachers did not refer to the TE policy document as frequently as required by the Department of Basic Education. In some cases, this was influenced by some of the TE teachers not having their own copy of the policy document in their teaching files. The lack of overall planning also contributed to the ineffective implementation of EE in TE. It was seen that the TE teachers include environmental content only if and when such topics arise whilst teaching. As a result, students are subjected to a variety of chaos in their schooling and in the world in general. This may indicate that teachers always face a degree of uncertainty about what and how they should actually be teaching (Fahim & Talabari, 2014).

The lack of guidelines from South Africa's Department of Basic Education could be contributing to the inadequate integration of environmental content in today's TE. In addition, the annual teaching plans (ATPs) provided by the facilitators are somewhat limited in that they stipulate what to teach, and teachers are subsequently bound to rushing through the syllabus in order to meet the prescribed work schedule. Intrinsically, topics that are not included in the ATP do not get to be taught in the classroom. Some of those topics which lack the required attention include environmental subjects. Even though the TE teachers acknowledged the utilization of some waste materials in the classroom, that reportedly only occurred when formal classroom teaching tasks were conducted. Tasks were found not to fully infuse EE, but were limited only to indoor learning, hence the integration of EE is never fully achieved.

The interviewed TE teachers mentioned recycling as one of the environmental topics that was easy to teach in the classroom, but that the integration happened only theoretically and only within the classroom. Schools generate waste all the time, but the absence of recycling only emphasizes that environmental matters are not seriously considered. A general lack of resources and support hinders the lessons given by TE teachers, making them resort to teaching practical topics only on a theoretical basis.

Littering in schools is a known issue, and the TE teachers acknowledged that the situation was contributed to by their school students. The TE teachers were not involved in environmental activities, nor in the celebration of environmental days which could help to enhance students' environmental knowledge and raise their awareness about environmental issues such as littering. Some schools make an attempt to engage in environmental activities and these special days in order to teach students about the environment in which they live.

Overcrowding in classrooms contributes to the use of a teacher-centered approach in South African schools, and shortages of learning and teaching support materials and other resources impede of effectiveness of the whole teaching and learning process. The TE teachers taught only in normal classrooms, since they lack access to laboratories. Such deficiencies in the facilities of South African schools gives the impression that educational issues and inequality are issues still yet to be addressed. In addition, TE is taught the same way as any other subject, i.e., it is taught within the confines of the classroom. The difficulties encountered by the TE teachers in their schools could be somewhat mitigated through professional development. Chaos theory considers learning as a holistic, constructive, and dynamic act (Trygestad, 1997). In the case of the current study, it was seen that learning was not constructive but chaotic, and that this was largely owing to challenges encountered in raising students' awareness about the environmental issue of littering.

6. CONCLUSION

The current study explored the challenges that impede TE teachers in delivering lessons aimed at raising students' awareness of littering. As discussed, the study revealed the various challenges that confront teachers in today's South African schools. Understanding chaos theory is seen as critical in order for a better understanding of the educational system, and to meet the rapidly changing needs of both today's students and their teachers (Fahim & Talabari 2014). The challenges that teachers encounter in today's schools call for curriculum designers and policymakers to appropriately align the curriculum.

This study can be said to have addressed a gap in the TE literature from the perspective of EE studies only having previously scrutinized singular issues, that and their theoretical framework having differed from the current study. The author therefore concludes that TE teachers in South African schools need to be better equipped with environmental pedagogies through inservice training so that they can incorporate environmental issues such as littering into their lessons.

7. SUGGESTIONS AND LIMITATIONS

The author suggests restructuring the PAT in order to ensure that its intention of teaching students about environmental issues is more attainable and realistic, and that content from the task is pre-examined through controlled testing. Further, the curriculum policy and the ATPs offered to teachers by facilitators/subject advisors should give clear direction for teachers to be able to teach students about the issue of littering.

The research design used in the current study was considered ideal based on the aim of the research, with chaos theory significantly applicable to the research design. However, the study was only conducted in one district in Gauteng Province, South Africa, and thus the results cannot be generalized to other research settings. Sampling also added further limitations to the study since it only focused on Grade 8 TE teachers.

DECLARATIONS

Conflicts of Interest: The author declares no conflict of interest.

Ethical Approval: The research ethics of the study were followed and the University of South Africa issued an approval under ethics number 2020/06/10/48502928/28/AM.

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