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Is Awareness on Plastic Pollution Being Raised in Schools? Understanding Perceptions of Primary and Secondary School Educators

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Abstract: Plastic pollution is a major global issue and its impacts on ecosystems and socioeconomic sectors lack comprehensive understanding. The integration of plastics issues into the educational system of both primary and secondary schools has often been overlooked, especially in Africa, presenting a major challenge to environmental awareness. Owing to the importance of early age awareness, this study aims to investigate whether plastic pollution issues are being integrated into South African primary and secondary education school curriculums. Using face-to-face interviews with senior educators, we address this research problem by investigating (i) the extent to which teachers cover components of plastic pollution, and (ii) educator understandings of plastic pollution within terrestrial and aquatic environments. The results indicate that plastic pollution has been integrated into the school curriculum in technology, natural science, geography, life science, life skills and life orientation subjects. However, there was a lack of integration of management practices for plastics littering, especially in secondary schools, and understanding of dangers among different habitat types. This highlights the need for better educational awareness on the plastic pollution problem at both primary and secondary school level, with increased environmental programs needed to educate schools on management practices and impacts.

Keywords: awareness; environmental education; environmental policy; plastic pollution; stakeholder partnerships; South Africa; primary school

1. Introduction

Plastic pollution is a global concern that has potentially far-reaching impacts on humans, fauna, soil and ecosystem functioning [1–6]. Plastic production has been increasing due to global demands for plastic products in various sectors such as domestic, industrial and health [7,8]. According to Geyer et al. [9], the durability of plastics makes them an attractive material to use and very resistant to degradation. A recent study estimated global plastic waste production at 6.3 billion Mt, with 9%

recycled, 12% incinerated (burned) and 79% discarded directly in open dumps and the natural environment [9]. These plastics persist in landfills and the natural environment, which continuously break down into smaller fragments that pose potential risks to humans and fauna [10–12]. Further, practices which manage plastics and other waste by incineration negatively impact air quality and human health, contributing to air pollution and climate change [13]. Plastics also block drains and littered plastic materials can hold water and create breeding grounds for problematic insect species such as mosquitoes, thus potentially exacerbating the spread of mosquito borne diseases [14].

Environmental plastic pollution is a challenging restoration and governance issue because it is associated with severe environmental problems, with complex solutions [15]. Furthermore, the costs of waste management activities are a heavy burden for cities and rural localities in developing countries. Several policies, including banning of plastic bags, have been implemented in multiple countries as a strategy for raising awareness and minimizing plastic use, although the effectiveness of these policies is often not visible at a local level [16]. According to African Impact, an organization actively involved in remediating issues of plastic pollution within the African context, ten rivers in Africa and Asia are the major plastic polluters, which end up in oceans globally (www.africanimpact.com/plastic-environmental-sustainability-programs-africa/). Furthermore, they approximate that 500 shipping containers of plastic waste are dumped in Africa every month. In South Africa specifically, over one million tons of plastic waste are thrown away every month. However, an immeasurable number of towns across the continent do not have an official waste management system and the few that do generally have poorly managed or broken systems (ibid.). The increase in this environmental problem also causes educators to perceive effective environmental education as a strong response to fight against the environmental crisis [17]. Environmental education provides students with opportunities to connect with complex environmental issues, and to develop positive attitudes, knowledge, and motivation to take environmental action [18,19].

With growing environmental problems globally, there has been a concurrent interest and need to respond to these problems through encouraging pro-environmental behavior as a pathway aimed towards achieving sustainability goals [20–22]. Steg and Vlek [23] highlighted that the quality of the environment is dependent strongly on human behavior patterns. The norm activation theory clearly explains the pro-environmental behavior as being caused by a chain reaction involving three variables, namely adverse consequence (i.e., awareness of oneself), ascribed responsibility (i.e., sense of responsibility) and personal norm (i.e., moral obligation to do or refrain from a certain behavior), to possible environmental consequences in this case [24,25]. Thus, pro-environmental behavior for the current study is characterized as a human behavior that intentionally seeks to minimize the negative environmental impact of one's actions on the natural environment (e.g., plastic reduction, raising awareness and education) [23]. The current study aims to examine environmental education behaviors aimed at shaping attitudes, beliefs and values that affect environmental ethical behaviors through knowledge and skills development, that will enable individuals to participate in supporting an ecologically- and socially-just society.

Environmental knowledge and attitudes are key elements for changing human actions [26]. Efforts have been made to introduce environmental education as a subject, or part of one, in the school curriculum across different countries, but the subject continuously faces severe limitations and implementation problems [17]. This limitation is mostly due to the lack of applicable and positive environmental attitudes by the school educators [17,27]. For effective implementation, educators should be thoroughly aware of environmental education aspects, as only then can they make future generations aware of these environmental problems, challenges and their possible solutions [17]. However, it has been noted that there is a significant discrepancy between people's attitudes and their actual behavior [19,28]. Therefore, it has been suggested that educators, being role models, should not only develop a positive attitude but also actually practice environmental protection behavior [19,27]. In turn, this will help in developing similar attitudes and actions in following generations.

Plastic pollution awareness should be more effective and efficient, with all stakeholders heavily involved. There is a lack of research regarding strategies and approaches educators are employing to teach environmental pollution, and particularly plastic pollution. To address this research problem, this paper thus aims to investigate whether plastic pollution awareness is being raised in South African rural primary and secondary schools. The study specifically aims to (i) assess whether educators cover plastic pollution in their school curriculum and find any evidence of personal motivation for this on their part to do so; and, (ii) assess the different roles played by educators in primary and secondary schools towards plastic pollution education.

2. Methods

2.1. Research Ethics

Ethical approval for this study was granted by the University of Venda Research Ethics Committee; number SES/18/ERM/10/1009. All participation in the study was voluntary and the researchers did not in any way coerce any individual into participating. We ensured that informed consent requirements were fulfilled and to help to protect participants' privacy, we applied two common standards: (i) confidentiality and (ii) anonymity. In addition, schools where educators had been interviewed were not mentioned by name but were given letters "A" to "D" to ensure confidentiality of information. The data were collected qualitatively using face-to-face interviews, whereby the principal, deputy principal and three senior teachers were interviewed individually.

2.2. Study Area

The study was carried out in Thohoyandou, South Africa (Figure 1). Thohoyandou is located in the Thulamela Municipality, Limpopo Province of South Africa, with an estimated household density and population of 17,345 and 89,427, respectively [29]. It is the administrative center of Vhembe District Municipality and Thulamela Local Municipality. The Thohoyandou total area coverage is 42.62 km² and the major economic sectors are commercial and subsistence agriculture. Informal small-scale trading is one of the most popular business ventures [29]. The literacy levels are estimated at 76%, with 20% and 4% having secondary and tertiary education, respectively. Twenty-seven percent of the population are formally employed with 46% unemployed (Statistics South Africa, 2016). Thohoyandou is considered a "rural town" surrounded by villages, with about 25 primary and 14 secondary schools within the area. Although the town is considered rural in a South African context, in the wider African context it could be considered modern given the presence of a university, high court and well-developed central business district. A sample of seven (primary $n = 3$; secondary $n = 4$) schools was randomly selected throughout Thohoyandou.

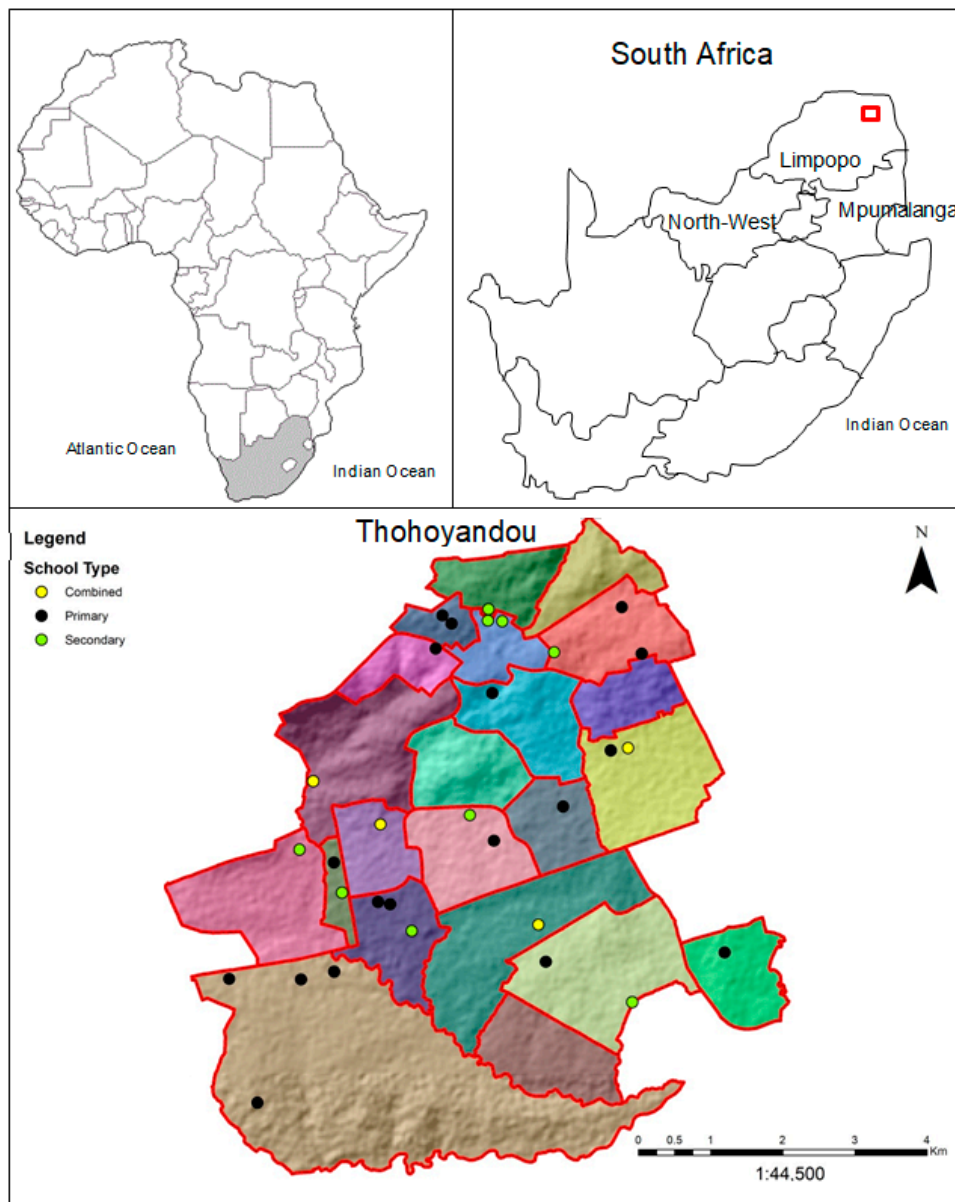


Figure 1. Location of the different primary and secondary schools found within Thohoyandou town, Limpopo Province of South Africa. The different colored areas represent the various residential areas/suburbs.

2.3. Sampling

A qualitative approach consisting of in-depth, semi-structured interviews (see Table 1) was used to describe and explore interviewees' perceptions to plastic pollution and education, and a general assessment of the educators' general environmental values, knowledge and attitudes, based on the new environmental paradigm approach [30]. Twenty-seven (primary $n = 11$; secondary $n = 16$; Table 2) educators were chosen in total, due to their involvement in school decision making processes, overseeing position within the schools, and/or key roles in developing planning strategies for the school curriculum. That is, educators were selected on the basis of their seniority, with principals or vice-principals included in the majority of schools. After 27 interviews, data saturation was reached to address the specific aims as no new or relevant information emerged. Thus, we addressed our findings based on five key research themes that covered a broad array of factors: (i) School environmental policies and codes of conduct (questions 1 and 3), (ii) environmental education and

awareness (questions 4 and 6), (iii) curriculum development (questions 2 and 8), (iv) stakeholder partnerships (questions 5), and (v) resource availability (question 7). These themes were selected on the basis of a review of secondary literature to identify major areas across a range of factors.

Table 1. The study interview questions administered to primary and secondary educators.

| Number | Question | Theme |
|--------|------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 1 | Are There Any Environmental Policies in the School that You are Aware of? | 1 |
| 2 | Within the curriculum is there any content that allows you to teach about pollution and specifically plastic pollution? | 3 |
| 3 | Are there any banned plastics in the school? | 1 |
| 4 | Are there any extra curricula activities or programs that increase environmental awareness such as picking up litter around the school or recycling? | 2 |
| 5 | Does the school have any networks with NGO's that promote environmental awareness? | 4 |
| 6 | Are there any resources (i.e., environmental awareness posters, flyers) allocated towards environmental education? | 2 |
| 7 | Do teachers consciously choose to use non plastics materials when they are teaching? | 5 |
| 8 | Do teachers feel it is important to teach about pollution and the specific dangers to the environment? | 3 |

Table 2. Twenty-seven different senior staff members interviewed during the study from 3 primary and 4 secondary government schools from Thohoyandou, Limpopo Province, South Africa.

| | Principal | Deputy Principal | Senior Teacher | | |
|------------------|-----------|------------------|----------------|---|---|
| | | | A | B | C |
| <i>Primary</i> | | | | | |
| A | x | x | x | x | x |
| B | | | x | x | |
| C | | x | x | x | x |
| <i>Secondary</i> | | | | | |
| A | x | x | x | x | x |
| B | | x | x | x | x |
| C | x | x | x | x | x |
| D | | | x | x | |

Face-to-face interviews were administered using the paper and pencil instrument method, and also the interviewees were recorded if they approved. In addition, photographs were taken to assess whether awareness on plastic pollution was being raised in schools and if resources were being provided towards environmental education. The interviews were conducted in either English or TshiVenda with the senior educators for about 30 to 45 min during the day. The raw transcribed data were raised to the different thematic levels described above using open coding [31] and further analyzed using the thematic approach described by Braun and Clarke [32] and Clarke and Braun [33].

2.4. Data Analysis

Chi-square analyses were conducted to assess the different levels of perception based on the Likert scale created for the different interview responses between the primary and secondary school educators within each theme using SPSS version 16 [34]. A two-point Likert scale was used with binary “yes” and “no” responses for each interview question. Separate tests were performed for each theme, enabling a comparison of primary and secondary school environmental education coverages.

We posed the null hypothesis that primary and secondary school educator attitudes towards plastics pollution would not differ, with respect to the aforementioned themes.

3. Results and Discussion

3.1. School Environmental Policies and Code of Conduct

Significant differences ($\chi^2 = 16.005$, $p = 0.001$) in primary and secondary school educator responses on environmental policy, code of conduct and banned plastics between schools were observed, with secondary schools having the most disagreements on plastic code of conduct and bans, and enforcing fewer policies and bans (Figures 2a and 3a,b). Punishments were imposed on pupils who failed to adhere to the code in only one school. Even though most of the educators highlighted that schools had a no littering code of conduct, a visual assessment of the school premises showed that most schools maintained a clean environment (Figure 3a,b), with the exception of primary school B (Figures 3 and 4c).

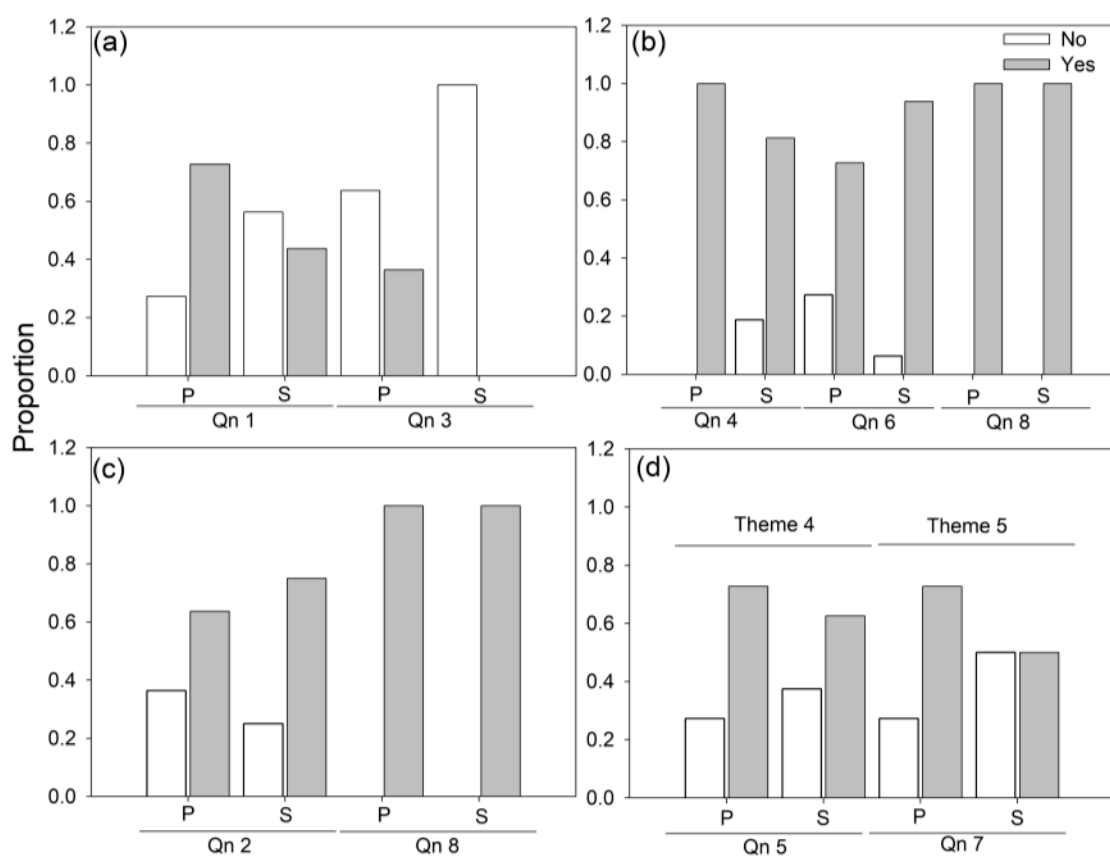


Figure 2. Two-point Likert scale (yes/no) responses, expressed as proportions, gathered from the 27 senior staff educators from primary (P) and secondary (S) schools interviewed for the five themes: (a) theme 1: environmental policy, (b) theme 2: education and awareness, (c) theme 3: curriculum development, and (d) themes 4: stakeholder partnerships and 5: resource availability. For question (Qn), see Table 1.



Figure 3. Methods initiated at selected schools to raise awareness among students within school premises: (a) Do not litter sign (primary school C), (b) school code of conduct sign with environment-related points 3 and 14 (primary school C), (c) educating students on environment (secondary school A), and (d) an environmental awareness chart in one of the class rooms (secondary school A).

“Secondary School B, Deputy-principal: *Yes, learners are not allowed to throw rubbish everywhere because we have rubbish bins in front of every class. On Wednesdays, rubbish from the bins must be collected. There are dire consequences if a learner is found littering in school grounds.”*

Schools have introduced plastic bins and instruct learners to use the bins for litter, thereby reducing the amount of plastics and other materials from being dumped into the immediate natural environment. However, both primary and secondary school educators highlighted that it was difficult to ban plastics from entering the school premises as most of the food items are sold packaged in plastics. Similarly, Adane and Muleta [35] and O’Brien and Thondhlana [19] highlighted widespread use, easy availability, and lack of alternatives as key drivers for continued plastic use. Therefore, both studies and the current indicated that there is motivation for promoting pro-environmental behavior, however the learners’ demographic background makes it challenging as there are few single-use plastic alternatives. Indeed, one primary school teacher highlighted that most learners are from poor backgrounds and generally

use plastic containers and bags to store or carry their stationery, making it difficult to ban non-reusable plastic within the school premises. O'Brien and Thondhlana [19] further highlighted that respondents used purchased plastic bags for other purposes similar to the current study. Thus, these learners are in fact promoting the re-use of plastic bags, but this comes at a cost for the environment as many are not durable, have a high turnover and can be easily discarded in the natural environment. As such, the promotion of alternatives for plastic and introducing subsidies could result in low or diminished use of plastic, yet most alternatives also come at a cost for the natural environment [19,36–39].

Secondary school B had posters to educate pupils on the need to protect the environment (Figure 3c,d). Hay and Thomas [40] highlighted that posters make sense as a means of communicating scientific investigation results quickly and effectively and also as an important teaching and learning aid. Pursitasari et al. [41] observed that students' responses improved when provided with a strong validation through content, presentation, and language via books and posters, which also assisted educators in the learning process, and improved students' critical thinking skills on environmental pollutions.

“Secondary, School B, Senior Teacher A: Yes, do not litter, there are also posters that encourage learners not to throw litter around and trees should be protected as they create a healthy and clean air environment.”

All secondary school educators highlighted that there were no banned plastic materials within the school premises, whereas 64% of primary school educators suggested that there were items banned. The observed results might have an impact on the schools and surrounding areas, including the general environmental policy at national and international levels.

“Primary School A, Teacher C: Yes, learners are reminded to pick any plastics and other materials and throw them in the dustbins.”

Most of the teachers were not knowledgeable, proactive and aware of the dangers of plastic pollution, and were not able to educate learners and take action against improper use, purchase and plastic disposal in the natural environment. However, it has been argued that being in positions of authority or being educated does not promote pro-environmental behavior [42]. Similarly, Kowalski [43] highlighted that some educators were not knowledgeable to plastic pollution prior to training or attending a plastic workshop. In primary school B, there was also a lack of understanding the potential dangers posed by plastics to the environment and also the burning of plastics by the educators.

“Primary School B, Senior Teacher A: Yes, keep the environment safe by not littering in the school grounds. For instance, burning of plastics and other materials is done after school hours when learners are not present to protect them from inhaling smoke as it will pose a health threat to them.”

Integration of plastic pollution issues in the school curriculum could enable teachers to discuss innovative ideas with learners so that they can mitigate the problems associated with plastic pollution in the wider environment. Several studies [44,45] are already advocating for greater education, outreach and awareness within schools as a way of protecting the environment and various practices may be fostered that lead to different perceptions of environmental protection. Thus, the learners would also be able to disseminate their knowledge gained with wider communities. Kolwaski [43] highlighted that students and educators generally had an improved understanding of plastic-related issues after training, which resulted in changes in behavior and attitudes.



Figure 4. Maintained and empty bins in (a) primary school C and (b) secondary school B, full and un-maintained bins (c) and (d) in primary school B in the Thohoyandou area, South Africa.

3.2. Education and Awareness

No significant differences ($\chi^2 = 10.617, p = 0.059$) in primary and secondary school educators were observed with regard to plastic pollution education and awareness (Figure 2b). Students were

encouraged to pick up litter both in primary and secondary schools. Thomas [46] noted that behavior change interventions in New Zealand schools resulted in a significant reduction in littering rates when used in conjunction with education, and also resulted in reduced amounts of plastic being brought into the school premises. In the present study, this was done through four different codes of conduct which were routinely identified in primary schools:

(a) General school rule;

“Primary School A, principal . . . early in the morning, learners pick up plastics and dirty materials and throw them in the dust bins”

(b) form of punishment;

“Primary School C, Teacher A . . . late comers pick litter in school grounds”

(c) form of incentive;

“Primary School A, Teacher C . . . last year there was a competition where learners challenged each other on keeping the school free of plastic and papers. In addition, the classes that won were foundation phase classes which start from grade R to grade 3”

(d) collaboration with solid waste-preneurs;

“Primary School B, Teacher B . . . there are people who come with bicycle carts to collect plastic materials and in turn send them for recycling in exchange for money”.

In secondary schools, the above sentiments were also shared by the educators; there were additional programs from outside private and non-governmental organizations which encouraged and instilled a sense of ownership to the environment to learners by teaching them about different types of plastics, different ways of recycling and the impacts of plastics on aquatic and terrestrial ecosystems. Similar to So and Chow [17], where educators used different strategies to improve pupils' involvement, the involvement of outside stakeholders can significantly improve the students' pro-environmental behavior. For instance, one educator highlighted that:

“Secondary School B, Teacher A . . . there is Limpopo Green Schools for the Earth which is a four-year program whereby learners and communities are part of it. It encourages people to protect water resources as most of the improperly managed plastics end up in rivers”.

With regards to resources available towards environmental education, it was clear that in both primary (73%) and secondary (94%) schools, most educators associated the availability of dustbins (question 6; Figure 4) as the only form of awareness about proper disposal of plastics. The way that different schools tackled waste management could easily be identified by how clean and empty the bins were within each school (see Figure 4) and was a key precursor to pro-environmental behavior attitude and awareness. In another school, a teacher explained that dustbins are labelled in a way that depicts which type of waste is to be disposed in them.

“Primary School A, Teacher A . . . dustbins are provided in the school yard so that plastics don't end up in the ground.”

“Secondary School, Teacher C . . . there are plenty dustbins around the school and are classified on what waste is disposed.”

Encouraging waste recycling in schools by educators has been found to generally improve students' attitudes and behavior towards general waste and the natural environment [22]. However, concerns have been raised that, despite the availability of rubbish bins, some students still do not throw waste in designated bins as they associate picking up waste with being the cleaners', janitors' and/or care takers' job. Similarly, Kanene [47] and So and Chow [17] highlighted that environmental education has failed to transform students' attitudes towards responsible and action-oriented environmental stewardship.

“Secondary School A, d/principal . . . the school has bought bins but learners lack interest on the issue of throwing litter in the bins. The reason behind is that they expect cleaners to pick up the litter as it is part of their jobs.”

All educators in both school types were very much aware of the impacts of plastic pollution in the environment, and aware of the plethora of challenges that emanate from the use of plastics. Teachers gave examples which showed that plastic pollution impacts the society at different scales. In primary schools, concerns about the probability of children suffocating as a result of improper disposal of plastics were raised.

“Primary School C, d/principal . . . because we are living in a dirty environment, so we should alert learners on the dangers of plastics as it may harm them in one way or the other. For instance, children might cover their faces with plastic and end up suffocating thus dying.”

Whilst the dangers of plastics on different land uses were raised:

“Primary School C, Teacher A . . . because plastics have been a global problem which results in death of birds, fish and livestock”.

For instance, one respondent mentioned that stray dogs and browsing goats that enter the school premises have suffocated after ingestion of plastics (**“Secondary School A, principal . . . because plastics may suffocate animals, for instance lingering goats and dogs that enter the school premises might eat them and end up suffocating”**). Whilst, other respondents cited that plastics are non-biodegradable and that burning of plastics results in toxic gases being released into the air, contributing to the greenhouse effect.

“Secondary School B, Teacher C . . . it is important because locally people burn plastics and other waste which releases dangerous gases that harm human health. Inhalation of gases released contributes to diseases such as asthma and lung diseases. In addition, burning of waste also adds the amount of heat in the environment which results in global warming.”

It is also interesting to note that in the secondary schools, burning of plastics was considered a way of disposing of plastic waste.

“Secondary School C, Teacher A . . . there are dustbins and a site where plastics and other waste are burnt.”

This is despite several studies [48,49] highlighting that plastic waste incineration was a major source of air pollution, and ~12% of plastics burnt released toxic pollutants which impact the climate, and threaten plant, animal and human health.

3.3. Curriculum Development

Responses from primary and secondary schools to theme three differed significantly for both question two and question eight ($\chi^2 = 10.058, p = 0.018$) (Table 1, Figure 2c). Overall, responses in both primary and secondary schools suggested that pollution as a general concept was accommodated within the existing curriculums, and educators had the opportunity to teach on the subject matter. However, it seems that the issue of plastic pollution is rarely taught and therefore, educators should be encouraged to train students to think about the environment in the context of the human body and health [50]. Several studies [51–55] have shown that students do not have sufficient knowledge to contribute to the development of environmental awareness habitats/attitudes. However, the latest changes in school policy and curricula confirm that the relevance of environmental education has been recognized around the world [54–56], but changes in school practice are lacking. Out of a total 27 responses in the present study, nine reported that no aspect of plastic pollution specifically is taught within the curriculum. This was mostly observed in the responses given by primary school teachers. Only the grade 7 teachers indicated that there was specific curricula content covering plastics:

“Primary school A, Teacher C: *Yes, in grade 7 there is a topic of matter and materials whereby learners are taught about the manufacturing of plastics and the environmental impacts they have on the environment.”*

Curriculum content for secondary schools covered aspects of pollution, and mostly water pollution rather than plastic pollution. Pollution was generally covered in the technology subjects, with life orientation also having components of pollution. Not all students study technology in secondary school, however, and this potentially limits the awareness on plastic pollution to all students and teachers. For instance, in European countries, Stokes et al. [57] and Stanišić and Maksić [54] pointed out environmental education is taught as a standalone subject or embedded within other subjects. Language teachers, for example, pointed out that they do not have any content on pollution in their subject. It is important to note that other areas such as Hong Kong allow educators to design their own school-based curriculum, where they are incorporating plastic pollution in all subjects given its importance as an everyday issue [17,53]. The people of Hong Kong waste millions of plastic bags and this waste causes an enormous pollution problem, and thus, plastic bag pollution was chosen as a lesson topic as it is a familiar issue with school students [17,53].

All secondary and primary school teachers felt it was important for them to teach about plastic pollution, yet the reasons for this varied. Although there was variation in the motivation for teaching plastic pollution, all teachers displayed knowledge on the general problems of plastic pollution, which include the difficulty of plastic disposal due to the non-biodegradable nature, the dangers to aquatic and terrestrial fauna, negative effects on aesthetics and their release of toxic gases if wrongly disposed of by burning. A senior member of staff did, however, point out that although educators responded in the affirmative to the importance of teaching on issues of plastic pollution, their own behavior seemed to contradict their beliefs:

“Secondary school C, deputy principal: *Yes, it is vital to ensure a green footprint, however, teachers do address the dangers of pollution, yet they (the teachers) litter daily . . . ”*

This observed behavior by the deputy principal highlights the challenges in trying to implement the pro-environmental behavior within schools when the educators have a negative attitude towards pollution i.e., littering.

3.4. Stakeholder Partnerships

Our results showed no significant differences ($\chi^2 = 3.307; p = 0.579$) between primary and secondary schools in terms of the existence of stakeholder partnerships or networks that promote environmental awareness (Figure 2d). The United Nations Sustainable Development Goal number 17 recognizes the importance of partnerships and collaborative governance in solving escalating ecological problems, meaning that collective capacity and knowledge roles are critical in finding key solutions [58,59]. Thus, organizations in the civil society, private and public sectors are experiencing pressure to address complex environmental challenges through collaborative action via multi-stakeholder partnerships. Mannathoko [60] observed that school-stakeholder partnerships provide an effective approach in curriculum development and implementation, and further promote students’ academic success and effective schooling in Botswana. The study further revealed benefits of school-stakeholder partnerships due to educators’ limited skills in the matter. In primary schools, the majority of the respondents agreed that there were networks within the area that played an important role in promoting environmental awareness. Indeed, private companies and volunteers within the community were found to be frequent networks mentioned in by primary school educators. In secondary schools, reference was made to the various programs that already existed in the community. For example, in response to the existence of networks that promotes awareness, one respondent said:

“Secondary School C, Deputy Principal: *Yes, there is Thohoyandou Victim Empowerment Programme (TVEP) that raises awareness on social problems and are addressing environmental*

problems. For instance, improper disposal of disposable nappies has impact on the environmental and human well-being as it ends up on roads and nearby rivers."

3.5. Resource Availability

Our results showed no significance differences ($\chi^2 = 1.395$; $p = 0.238$) between primary and secondary schools in resource availability that promotes environmental awareness (Figure 2d). Liefländer and Bogner [61] observed that system knowledge may also influence utilization, i.e., students who desisted from (ab)using nature also seem to put more effort into improving their environmental knowledge, and/or students who engage in learning about the environment will become less exploitative towards the environment. Thus, it should be noted that the environmental knowledge promotion is often viewed as a fundamental environmental education component and an essential prerequisite to ecological behavior; however, it has little effect on actual individual behavior [62]. Resources allocated towards environmental education in the sampled schools include textbooks, dustbins and posters. Environmental protection education textbooks and posters have been highlighted to play a significant role in students' pro-environmental behavior [41]. Dustbins are the most utilized resource allocated in every sampled school as they educate learners regarding where to throw litter, thus making the immediate environment look tidy. However, learners and educators often ignore throwing litter in the bins provided and litter the school ground instead. Such individualistic behaviors have been attributed to most environmental problems [63] and need to change in order to move towards more environmentally responsible schools and sustainable societies [64]. Otto and Pensini [62] further observed that increased nature-based environmental education participation was related to greater ecological behavior, mediated by increases in environmental knowledge and connectedness to nature which was lacking from the educators.

As such, issues related to resources availability cannot be neglected. Our results also show that on one hand, students are educated in the context of pro-environmental behavior (for example, how to separate reduce, recycle and reuse), whilst on the other hand, the schools do not make it feasible to practice this behavior by not providing the necessary resources. Although bins were commonly mentioned to be available, most schools did not have clearly labelled bins for separating waste (for example, plastic, paper, organic waste). These structural changes are needed in both primary and secondary schools, which concurs with Kullmuss and Agyeman FF [65].

4. Conclusions

The results indicate that plastic pollution has been integrated into the school curriculum in technology, natural science, geography, life science, life skills and life orientation subjects. However, there was a lack of integration of management practices for plastics littering, especially in secondary schools, and understanding of dangers among different habitat types. The present study thematically identifies key areas relating to plastics pollution awareness and management which are lacking in primary and secondary schools. Therefore, environmental programs that include emerging pollutants such as plastic among private, non-governmental organizations and government should be developed to help students to better understand the interactions between human activities and the natural environment, as well as the environmental problems they face locally and globally. Future research should additionally: (i) examine the perspectives of learners as well as educators when examining the efficacy of environmental education programs; (ii) expand research into many schools across different countries/regions to gain a better understanding of plastic pollution additions to the school curriculum, and; (iii) further assess the relationship between environmental education and educators' environmental perception in regards to learners' behavior. It is also important to note the next generation cannot contribute sufficiently to alleviating these problems in their daily lives and will need the input of all stakeholders in the private and public sectors. Thus, the education of all other stakeholders in the circular economy (i.e., consumers, designers and manufacturers) on the whole process surrounding pollution is additionally important. Nevertheless, there are several challenges and

opportunities that exist within environmental education with regards to plastics in schools, as indicated in the present study.

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