Innovative Community Projects to Educate Informal Settlement Inhabitants in the Sustainment of the Natural Environment

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Abstract: Increasing informal settlements are characterised by unplanned land management; lack of housing, sanitation, sufficient water and electricity supplies; overpopulation; high health risks; and growing urban poverty. These informal settlements are mostly occupied by citizens and immigrant families who seek job opportunities in urban areas. To sustain the ecology of the invaded land and provide a liveable informal settlement, education of the inhabitants is essential. Teachers as the implementers of sustainable environment curricula could be valuable in addressing the environmental challenges these informal settlement communities experience by educating children on how to sustain the environment. Data were collected by means of a literature study and an online survey consisting of closed and open-ended questions completed by student teachers (n = 280). Participants' perceptions, perspectives, and experiences regarding educating informal settlement inhabitants in the sustainment of the environment were significant in answering the research questions. Most of the participants (n = 216) had visited informal settings, 48 were inhabitants, and 16 had never visited an informal settlement. Most of them believed that educating children at an early age and the inclusion of a compulsory subject on the sustainability of the environment were essential. Education can contribute to the sustainment of clean water, food, and the environment. Additionally, interactive community projects such as recycling, waste management, composting, aquaponics to grow plants, and infrared thermal imaging to detect plant diseases could assist informal settlement inhabitants in sustaining the environment.

Keywords: informal setting; environmental sustainability; e-waste; waste management; aquaponics; pollution; infrared thermal imaging; education

1. Introduction

Population growth and rapid urbanisation lead to the development of informal settlements, which have become a challenge for most third world countries [1]. The United Nations [2] projects that the world’s population could reach 9.7 billion in 2050, which would increase the demand for land, natural resources, and jobs. Poverty and a lack of job opportunities cause a migration of dwellers to urban areas despite their inability to afford and access formal housing [3]. This results in the growth of erected informal settlements around cities.

Statistics South Africa [4] indicates that there are about 2.2 million inhabitants of informal settlements in the country and the numbers are increasing annually. Such informal settlements are characterised by unplanned land management; a lack of housing and sanitation; water and air pollution; insufficient water and electricity supplies; overpopulation; high health risks; and growing urban poverty [5]. These informal dwellings not only put the sustainment of the natural environment at risk but also increase the spreading of diseases among the inhabitants.
According to Säumel, Reddy and Wachtel [6], the well-being of city dwellers and sustainment of the environment are dependent on effective environmental management in low-income settlements. Despite the implementation of various policies and strategies to ‘solve and prevent’ high-risk informal settlements and to maintain the natural environment, the issue has not been solved. Research shows that policies alone cannot ensure the successful sustainment of the environment and that education of children and the interactive participation of the community could contribute valuably [7].

McKeown [8] asserts that educating inhabitants about the value of natural resources is essential for sustaining the ecology of the invaded land and providing liveable informal settlements. Huchzermeyer [9] agrees and states the importance of community engagement in educating informal dwellers about how to maintain their natural environment and how to manage the challenges they encounter. In educating inhabitants, teachers play a significant role when teaching children living in these informal settlements about related topics on how to sustain the environment. Meier and Sisk-Hilton [10] postulate that children should be educated from an early age on how to save natural resources as values and morals.

In agreement, Siraj-Blatchford, Taggart, Sylva, Sammons, and Melhuish [11] advocate that successful sustainment of the environment is largely dependent on how the next generation is educated. Learning begins at birth and if children develop sustainable development skills, their experiences can be sustained for future generations [12]. According to the United Nations [13], literacy and numeracy as foundational skills for young children are building blocks for lifelong learning. Children develop not only problem solving and analytical skills, but also values and attitudes that enable them to respond to global changes. The teacher as facilitator plays an important role in guiding children’s attention towards the economic impact of an unsustained environment, environmental challenges, and the importance of interaction with communities to ensure the sustainment of the environment [14].

Moreover, parents as educators and role models of the family’s beliefs, values, and attitudes could positively or negatively influence children’s views on how to sustain the environment [15]. Damerell, Howe and Milner-Gulland [16] add that educated children could possibly change parents’ established negative environmentally harmful attitudes and behaviours in a positive manner. Effective education develops environmental consciousness and improves the understanding of environmental issues and climate change [17]. The World Values Survey of 2010–2012 showed that children with a secondary education favoured the environment above economic development and tended to engage in activism that protects the environment [17]. In addition, the community could contribute with various innovative programmes to address the challenges and save the natural environment occupied by informal settlement dwellers. Based on research findings that education and interactive community engagement projects could positively influence the behaviours of adults and children, the research aimed to investigate possible innovative practices that student teachers could apply in their teaching and learning programme to sustain the environment. Therefore, the study sought to answer the following questions:

- What are student teachers’ perceptions concerning the impact of informal settlements on the sustainability of the environment?
- What innovative solutions to sustain the natural environment can teachers apply in teaching and learning programmes?

1.1. South African Context

Like other third-world countries, South Africa is challenged with urbanisation and the provision of suitable housing for all citizens. The United Nations [2] points out that by 2050, 68% of the global population could be living in urban areas. In 2015, Africa, with the second highest population growth in the world, had almost 200 million slum dwellers, which adds to serious challenges concerning housing and basic services and the growth of informal settlements [18]. Informal (low-income) settlements can be defined as temporary structures or dwellings that are built out of rudimentary materials in residential areas where inhabitants squat or rent informally, lacking basic services, resources, and
city infrastructure. Such housing does not comply with building regulations and is often located in environmentally sensitive areas [19].

According to Statistics South Africa’s Household Survey [20], more than five million (11.4%) Black; 276,348 Coloured; 117,000 Indian; and 13,310 White citizens live either in informal dwellings or in the lowest housing bracket. These informal settlements add extra pressure on already struggling provision of health care, sustainment of the environment, security, and equal education opportunities for all.

Considering the available resources, sustainment of the environment and the need for adequate housing have contributed to various legal actions by the national, provincial, and local governments.

1.2. Policies and Government

After apartheid and the new government’s promises of improvement of service delivery and the provision of free housing, disadvantaged South Africans believed that their circumstances would change. Although the post-apartheid political leadership planned to deliver one million houses in its first term, the 1994 Housing White Paper [21] does not refer to the eradication of informal settlements, and merely refers to these settlements as examples of a housing backlog. Thus, the government did not predict that informal settlements would increase and would need upgrading as the population growth expanded [22]. However, the failure to address these issues has contributed to the growth of poorly serviced informal settlements in urban areas [23].

To address the growth of informal settlements, the Constitution of the Republic of South Africa [24] was implemented in 1996, where Section 26 stipulates that it is the responsibility of the government to use available resources to ensure the provision of sustainable services to communities, and to promote a healthy and safe living environment for all citizens. However, its implementation failed to comply with its vision. Moreover, Section 24 of the Constitution specifies that the environment should be protected for future generations, pollution and damage to our natural resources prevented, conservation promoted, the development of natural resources ensured, economic and social development of people promoted, and that every citizen is entitled to living in an environment that will not risk their wellbeing or health [25]. Nevertheless, informal settlements still deviate from the Constitution as they pose a risk to the environment’s sustainment and inhabitants’ health. According to Du Plessis [25], informal settlements disrespect the Constitution, as pollution and deforestation are typical of such settlements. Adlard [26] refers to Section 153 of the Constitution, which states municipalities must administer, budget and plan how to address the basic needs of the community and at the same time uphold their social and economic development. It could be assumed that if Section 153 were implemented and well managed by municipalities, the growth of informal settlements would be arrested.

In 1997, the framework of the national housing policy as set out in the Housing Act No. 107 indicated that every municipality needs to ensure that its inhabitants have access to housing and related services [21]. Huchzermeyer [27] indicated that by the year 2000 the South African government could not comply with the upgrading of informal settlements and focused on the relocation of households from informal settlements to temporary relocation areas (transit camps), which again embraced a continuation of apartheid practice.

In 2004, Breaking New Ground [28] saw a need for a new policy that would support the development of a non-racial, integrated society and envisioned the following plan: accelerate the development of quality housing; develop sustainable human settlements; utilise the building of houses as a strategy to provide more jobs; combat crime; promote social cohesion; improve quality of life; and reduce duality by dismantling the barriers between rich and poor residential properties.

Despite various policies, local communities do not always consider all citizens’ needs, knowledge and interest when allocating financial support or planning training programs on how to sustain the environment. Often, the city image is of more importance than establishing the core values and social experiences of inhabitants [29]. Lombard [30]
suggests involving all citizens actively. More focus is needed to explore ‘place-making’ of inhabitants to detect their lived experiences and to connect their social relations with spatial construction. The ‘place’ of inhabitants concerns the physical place they stay in and getting to know the background of people to involve them actively in urban activities. This information could result in more knowledge concerning the territorial, poverty, psychosocial, and emotional dimensions of the urban environment which are often overlooked by policy makers when planning programmes in sustaining the environment.

1.3. The Impact of Informal Settlements on a Sustainable Environment

Dwellers of informal settlements build houses using temporary structures or rudimentary materials—asbestos and sheets of corrugated iron—which contribute to life-threatening pollutants when exposed to fire. These fires not only cause air pollution but could cause lung diseases [31].

Clean air, water, plants, and food supplies are essential for human survival. The dependence of humans on the environment requires that humans take care of the consumption of environmental resources. However, informal settlements endanger the sustainment of the natural environment [31]. Most informal settlers use energy sources such as fires, coal, electricity which is illegally connected, and paraffin and gas that release harmful gases into the atmosphere and risk fires in the settlements.

Additionally, there is the increase and the ineffective removal of waste, which causes land pollution and impacts negatively on the environment [32]. Lack of waste management in informal settlements affects clean water sources as sewage and other waste such as laundry, kitchen, bath, and domestically used liquids are discharged into clean water sources. Contaminated water and a lack of sanitation contribute to diarrhoea and waterborne diseases [31].

Debrah, Vidal and Dinis [33] point out that not only are natural forests being invaded by informal settlements, but trees are cut down for fires and to build informal housing. This leads to environmental degradation due to a loss of vegetation, causing soil erosion where soils are washed into rivers and ground and pure water reduced. Another concern is the increment in inhabitants’ numbers: as they increase, waste and land pollution increases, because of the high density of inhabitants and ineffective waste disposal [33].

Moreover, children living in informal settlements are growing up with technology devices (such as cell phones, tablets, and iPads). The increased usage of such devices poses a risk for the natural environment when these become outdated and not usable anymore. Electronic waste (e-waste) cannot be easily disposed of like other waste material as it consists of toxic metals and could affect the health of inhabitants [34]. Perkins, Drisse, Nxele, and Sly [35] assert that e-waste has the worst effect on the environment compared to other types of waste.

The way humans maintain the natural environment that they occupy can be related to their housing needs, socioeconomic situation, and education [36]. The Ecological Systems Theory identifies the influence of diverse types of environmental systems on human development. According to Bronfenbrenner [37], this theory explains why we behave differently when we are at home or away from home. Thus, people living in informal settlements will treat their environment according to their socioeconomic and housing needs, which consequently leads to deforestation and the degradation of the land. The way this theory is applied is to establish how informal settlements impact the environment negatively and how they could be educated to improve the sustainment of the environment. Bronfenbrenner’s theory [37] investigates the interactions and relationships between humans and the environment and among humans themselves and the negative impact on the environment of these interactions.

Consistent with the theory, informal settlements could impact negatively on the environment because of the socioeconomic situation they find themselves in. Individuals’ behavioural patterns in relation to their culture, values, and education are transmitted from adults to children from an early age, also in how to respect and sustain the environ-
Kohlberg [38] confirms that a child’s moral development can change throughout life and that early interaction with real-life situations and education on how to sustain their environment could lead to a permanent behavioural change. Therefore, the study sought to find solutions for educating children in informal settlements on maintaining the environment.

2. Materials and Methods

A descriptive research design was used to collect holistic data from literature reviews and student teachers’ perspectives concerning the characteristics of informal settlements, the impact inhabitants have on the sustainment of the environment, and innovative practices that could be applied to educate them. The perspectives deriving from a younger generation of educators’ reflections on their own experiences and innovative ideas contribute to the originality of this paper in how education can be applied in future studies to sustain the environment.

The study investigated participants’ perspectives, experiences, and innovative ideas regarding the education of informal settlement inhabitants in the sustainment of the environment. Qualitative data were gathered from student teachers (n = 280) of a university in Pretoria using online surveys. The institution is situated in a township of South Africa and most participants were from poor and disadvantaged socioeconomic contexts.

Data were collected by means of a literature study and an online survey consisting of closed and open-ended questions to establish student teachers’ perceptions on the impact of informal settlements on the sustainability of the environment. The literature study was used to acquire previous research findings on how to educate informal settlement dwellers and to compile relevant closed and open-ended questions for further investigation. An online link was sent to student teachers for completing the questions. Student teachers were involved in the study as they will be teaching the future generation and because most of them are from poor social contexts, live in informal settlements and encounter the same experiences as informal settlement inhabitants. Thus, their perceptions were important to gain a better understanding of how they experience and observe informal settlements and at the same time to create an awareness that would encourage them to educate children and adults to maintain the natural environment under difficult circumstances.

Analysis of Participants’ Responses

For understanding who participants were and to detect their experiences of informal settlements, closed questions were answered. Firstly, student teachers were requested to indicate their gender. The majority were male (n = 58%) and 42% were females. The reason could be that more male student teachers are currently studying to become teachers. The second question aimed to detect how many were living in an informal settlement, which could contribute to valuable inputs. The results showed that only 48 of the participants lived in informal settlements. The numbers could be larger, as students might be sensitive to the stigma attached to living in an informal settlement. This might therefore not be a true reflection of the actual numbers. Responses to the third question were interesting: most of the participants (n = 264) reflected that they either lived in or had visited an informal settlement, while only 16 student teachers had never visited an informal settlement. As most participants had either visited or stayed in informal settlements and were teachers who would soon be teaching these children in schools, their views were considered significant for finding solutions on how to educate inhabitants to sustain the environment in crowded spaces.

3. Results

3.1. Participants’ Responses to Open-Ended Questions

Most participants contributed similar responses that were grouped together using common themes. Edited transcriptions are provided below for the sake of clarity. Themes were extracted from responses for both questions 1 and 2.
3.1.1. Question 1: What Is Your Observation Concerning the Situation of Inhabitants of Informal Settlements and the Impact They Have on the Sustainability of the Environment?

**Poverty**

“Many people who stay in these informal settlements are poor. More people of today are still struggling to find job opportunities; therefore, they have to use available natural resources in the settlement”.

**Security Risk**

“The informal environment is not safe; due to poverty many people steal from one another . . . ”.

**Overcrowding and Spreading of Diseases**

“Informal settlements are overpopulated, and people have to travel far distances to buy groceries as they are unable to grow their own food due to lack of space”.  

“It has a negative impact towards the residents because most of the time there’s no hygiene and they suffer from diseases like diarrhoea”.

“In these places there is no proper or no service delivery at all. The living environment of these people exposes them to health risks, they get sick easily”.

“Staying at an overcrowded place can be dangerous; when someone gets sick, we all are at risk, especially with the Covid 19 virus”.

Informal settlements are overpopulated [1,2,4], do not have land to plant their own food; and lack proper hygiene and services, which causes inhabitants to easily contract diseases from one another. Nasser and Elsayed [5] agree that these informal settlements lack basic infrastructure, services, and resources, which further compromises the already struggling provision of sufficient health care in the country. Thus, the spreading of the COVID-19 virus also cannot effectively be managed in these settlements.

**Sewerage Disposal and Contaminated Water**

“There are no sewerage systems and the place is always dirty. There is usually a large population living on one place”.

“. . . no supply of clean and safe water and proper sanitation which proceed to harm the inhabitants of the settlements”.

“. . . there is a lack of basic services of waste removal, electricity and the build of a sewerage system which cause many of the sewerage to be flowing into dams and sources of everyday drink water”.

Overpopulation and a lack of sanitation contribute to contaminated water, diarrhoea, water-borne diseases [31] and land pollution, which negatively affect the environment and the health of inhabitants. Additionally, responses reflected that informal settlements are not planned and have no services, such as waste removal, electricity supply, or free running tap water, which causes dwellers to be dependent on polluted water and disposing their waste in the nearby rivers. A lack of waste management contaminates clean water sources as sewage and other waste are spilled into such sources [32].

**Waste Pollution**

“I see people dump their waste everywhere in the road. Some burn their waste products next to their houses and this cause pollution in the water and air and affect people who inhale dirty oxygen”.

“. . . waste products pollute the area because the municipality does not collect the garbage”.
“Many of the inhabitants use electronic equipment that becomes outdated and are dumped near their houses. The management of electronic waste should be educated in the curricula”.

**Hazardous Fires**

“Many poor people tend to live in an informal settlement as it is cheaper to rent or build a “shack” (a building made of corrugated iron, wood or hardboard) than renting a flat. Over-population and these shacks built with scrap metal and cardboard material can easily ignite a fire and put thousands of people’s life at risk”.

“... waste pollution increases the risks of hazardous fires as the waste is mostly plastic and paper”.

To find innovative solutions to sustaining a natural environment, the following question was posed to all participants:

3.1.2. Question 2: What Innovative Solutions Can Be Applied to Maintain the Natural Environment in an Informal Settlement?

**Education**

All participants indicated, in some way or another, the importance of education, for example:

“People need to be knowledgeable and adhere to the rules and regulations of the country, in how to maintain the environment”.

“... include a compulsory subject called ‘sustainability of the environment’ for all grades in school”.

“... Education should start at an early age as young as three years old and should never stop”.

“... integrate topics on the sustainment of the environment in each and every subject as a section of the topic taught”.

Participants agreed that inhabitants needed to be educated at an early age—as young as three years old—in how to sustain the environment. It was recommended that a compulsory subject in how to sustain the environment be implemented or related topics on environment sustainment integrated in all school subjects.

**Recycling**

“Teach them to recycle and reuse waste products and not to litter in the water to reduce land pollution and the burning of waste products that could cause shack fires”.

“Various dustbins for plastics, bottles and paper can be placed to recycle and emptied every week by recycling companies”.

“... start community projects that will help clean up the waste and maintain it and teach them to adhere to the waste management rules and regulations”.

“Make a dump site where everyone could dump the waste and empower them to recycle, reuse, and reduce the waste that they produce”.

**Play Activities**

“... create colourful posters and recycling games that will teach children to keep the environment clean”.

“Use playful activities and puppet shows where children and adults can learn about the dangers of pollution and how it could impact on their health and wellbeing”.
Creative Arts

“I will teach the children in these settlements songs and dances that they can sing while cleaning up the environment”.

“... in teaching the children I will encourage them to also teach their parents at home to take care of waste and to not dump in road or river”.

“Inhabitants can use drawings and paintings on their houses in teaching others how to avoid pollution and keep the environment safe. It will also become a more colourful settlement”.

Interestingly, some of the responses reflected that they would use songs and dances to encourage inhabitants to clean up while singing and dancing. It was also suggested that the application of drawings and paintings illustrating the avoidance of pollution and keeping the settlement safe could educate inhabitants and create a more colourful environment.

Collaboration and Teamwork

“Teach children from a young age to work together to clean up their environment. They can divide the informal settlement in groups that get a turn each and every week to clean a specific area”.

Many of the responses emphasised the importance of learning to work together as a team in cleaning up the environment.

Community Projects

“... teach them to plant food. Extra land can be allocated to plant and sell vegetables and fruits to fight hunger and poverty and at the same time earn money to improve their lifestyle”.

“... I will find a sponsorship from the community and hand out black refuse bags for willing inhabitants and ask them to work in groups of three or more to fill the bags with recyclable items. Once they have filled the bags, they can each get a hot dog to eat and at the same time sell the bags containing recyclable items to a waste management company”.

“... community sponsorships can assist with aquaponics equipment and training to assist inhabitants to grow and produce their own fish and vegetables in a small space”.

“... As a Life Sciences teacher I have experienced the effect that infrared thermal imaging has on the early detection of possible plant diseases. These cameras can be used by a community leader to help inhabitants to avoid a disastrous crop in their small gardens in advance”.

Respondents recommended collaborative involvement of inhabitants in community engagement projects that could assist them to grow their own food on a small piece of land. Thus, the community could engage inhabitants in various innovative programmes to address their challenges and save the natural environment. For example: “infrared thermal imaging” could assist inhabitants to detect plant diseases and ensure healthy plants.

4. Discussion

The world faces many environmental challenges resulting from growth in population, consumption, and technology [2]. The increase of the population and a lack of job opportunities [3] give rise to more informal settlements that impact the sustainment of the environment. A lack of job opportunities causes dwellers to migrate to urban areas despite their inability to afford and access apartments or housing [3]. Poverty-stricken people live in “shacks” as they are cheaper to rent or build than renting a flat. Debrah et al. [33] assert that trees are cut down to build these informal houses and to make fires. In defence, responses indicated that due to their socioeconomic status, education, and housing needs, they had
no option but to make use of available natural resources, which resulted in deforestation and the depletion of the land. Participants also pointed out that shacks built with scrap metal and cardboard material can easily ignite and put thousands of people’s lives at risk. In addition, as waste pollution increases, the risk of hazardous fires escalates, since the waste consists mostly of plastic and paper and inhabitants use fires to cook. Mathee [31] points out that due to the high population density, the fire risk increases as inhabitants used fires to cook, connect electricity illegally and use paraffin stoves and gas that release harmful gases. These fires not only cause air pollution but could cause lung diseases [31]. Du Plessis [25] argues that informal settlements disrespect the Constitution and policies as pollution is a main characteristic of such settlements. Elaborating, Hamann et al. [7] and Huchzermeyer [9] indicate that policies alone cannot ensure the successful sustainment of the environment and that interactive engagement of the community and inhabitants is essential.

Additionally, results indicated that informal settlements are overpopulated, noisy, and people tend to dump their waste everywhere in the streets or burn their waste products next to their houses, which causes severe water and air pollution that affects people who inhale polluted air. Poverty-stricken people live in “shacks”. In finding a solution for limited soil and to grow plants successfully, inhabitants could plant crops and take photos of crops with infrared thermal imaging cameras to detect possible diseases through the extraction and analysis of colour, shape, and texture [39]. The leaves of the plants are then treated to avoid the spread of crop diseases and to ensure a healthy crop. Additionally, another initiative could include aquaponics. Bailey and Ferrarezi [40] claim that aquaponics, although initially costly, could offer a solution to several sustainability issues, such as environmental pollution, limited water availability and an increase in population and waste products. For example, in the aquaponics system, two tanks can be placed on top of each other: in the top tank plants and the bottom tank fish (Tilapia/Carp or African Catfish). The waste produced by aquatic organisms in the fish tank is then filtered through to the top plant tank where natural microbes occur, and organic compounds are broken down and consumed by the plants. Thus, the fish tank is loaded with nutrients, which are filtered into a hydroponic system where plant roots are fertilised to grow. The water is then recycled back to the aquatic bottom fish tank. Leafy vegetables grow well in an aquaponics system and have a short growing period [40]. The advantages of aquaponics for informal settlements are that it has a highly effective water usage, a low need for soil; minimal if any synthetic fertilisers, pesticides/herbicides or antibiotics are used; it produces plants and fish that can be sold and consumed, and limits waste into the environment [41].

The Constitution of the Republic of South Africa [24] strives not only to protect the environment but also to ensure that all citizens live in an environment that will not risk their wellbeing or health [25]. However, overpopulation and a lack of sufficient and effective sewerage disposal pose a high health risk due to limited access to clean and healthy water [22,23]. There is a lack of basic services of waste removal and a working sewerage system, causing most of the sewerage to flow into dams and drinking water sources. If sewerage pipes are available, they tend to leak, or the community uses pit toilets, the effluent of which also lands up in the drinking water. Thus, health risks are high because of poor hygiene, poor health care and insufficient resources and services in the area. The increase of inhabitants’ numbers contributes to severe challenges such as a lack of housing and sanitation; water and air pollution; health risks; insufficient water and electricity supplies; growing urban poverty; the increased spread of diseases among the inhabitants; and a risk to the sustainment of the natural environment.

Moreover, as the population grows, crime increases. Participants’ responses reveal that inhabitants of informal settlements are poor and jobless, which causes an increased security risk. This places extra pressure on the community and the government to safeguard inhabitants against crime [20,28]. Since 2004, Breaking New Ground [28] has envisioned combating crime in these informal settlements and providing more jobs for dwellers by building houses that could improve their quality of life. Nevertheless, the ever-growing
population in informal settlements, insufficient funding, and paucity of resources administered by municipalities have impeded the achievement of this vision [26].

As inhabitants are inclined to make use of natural resources due to poverty, McKeown [8] emphasises that inhabitants should be educated on the value of natural resources to sustain the ecology of invaded land. Humans need to take care of their environment as clean water, air, food and plants are vital for human survival [31]. Education of the population is considered essential to maintain the environment and environment protection policies need to be adhered to. Govender, Barnes, and Pieper [42] agree with suggestions of participants that the threat informal settlements pose for the sustainment of the natural environment can be addressed by education, providing low-cost housing, recycling waste products, community initiatives, such as clean-up groups, controlling fires, and government intervention within the governance of the settlement. Additionally, all inhabitants should be trained and educated in how to recycle plastic, glass, paper, and household waste to sustain the environment. In agreement, Seymore [36] asserts that the way humans maintain the natural environment can be related to their education and socioeconomic needs. Bronfenbrenner [37] elaborates in stating that individuals’ behavioural patterns accord with their education, culture, and values, which are transmitted from adults to children from an early age. Lombard [30] emphasises the importance of focusing on ‘place-making’ of inhabitants to detect their lived social experiences, core values and emotions when planning education programmes in sustaining the environment rather than relying on the creation of a city’s image.

Limitations of the Study

This study shows some limitations. The data of the study were compiled from only two open-ended questions and student teachers’ perspectives from only one disadvantaged institution. Additional research questions and perspectives of informal settlement inhabitants, experienced teachers, and student teachers from diverse institutions could add more value to a follow-up study.

5. Conclusions

Population growth leads to urbanisation and an increase of informal settlements, which place the natural environment at risk. The inhabitants of informal settlements have an impact on the natural forests—cutting off trees to build houses and make fires contributes to soil erosion and a loss of vegetation. Additionally, they tend to use natural life-threatening pollutants such as coal, gas and paraffin that release hazardous gases into the atmosphere. With the increase of informal settlement numbers, growing numbers of discarded obsolete technology devices pose a risk for the natural environment.

The way informal settlement inhabitants maintain the natural environment depends on their survival needs and education. Therefore, the perspectives of student teachers as the new generation of educators were significant in this study as most of them frequently visited or grew up in informal settlements themselves. They indicated that children need education at an early age and proposed the inclusion of a compulsory subject on the sustainability of the environment. This subject should possibly include topics on pollution; waste recycling (e-waste, plastic, glass, paper, and household waste); how to generate compost with rich organic materials to ensure effective plant growth; and saving clean water to maintain the environment.

Various interactive community projects could assist informal settlement inhabitants in sustaining the environment, such as recycling, waste management, composting, infrared thermal imaging to detect plant diseases and aquaponics to grow plants. Aquaponics is recommended for informal settlements as it needs small pieces of soil, limits waste in the environment, has a highly effective water usage; requires few pesticides and fertilisers, and both plants and fish can be produced and sold for an income.
The practical implication of the study is that student teachers’ perspectives and innovative ideas could deliver interesting and innovative concepts for future research and can be regarded as building blocks for new theories and the extension of existing theories.

**Recommendations**

Participants’ innovative recommendations in this study are considered significant in finding solutions for how to educate children and their parents in informal settlements for sustaining the environment. From their experiences, they could relate to the needs of the inhabitants, as most of them had either visited or stayed in informal settlements and would soon be teaching these children in schools. Practically, inhabitants can be educated on how to recycle and use a waste removal skip where all household waste is accumulated to generate compost that contains rich organic materials [38]. The compost can be used to grow their own vegetables in small community gardens and at the same time provide food for the poor. Willing inhabitants could request the community to donate black refuse bags and request inhabitants to work in groups and fill the bags with recyclable items which they could sell again. The objective is to teach them to recycle, reuse, and reduce the waste that they generate.

Community projects that involve the active participation of citizens and financial support are essential to educate and support inhabitants. For example: organise “clean up” teams to help cleaning waste and at the same time teach dwellers to adhere to the waste management rules and regulations; teach children from a young age to work together and to clean up their environment; divide the informal settlements into groups where each group gets a turn every week to clean a specific area; use play activities and create recycling games that will teach children to keep the environment clean in a playful manner; teach them to plant food—extra land can be allocated to plant and sell vegetables and fruit to fight hunger and poverty and at the same time money could be earned to improve their lifestyles; infrared thermal imaging could be applied to detect plant diseases at an early stage and ensure a healthy crop; aquaponics, although costly, could offer a solution to several sustainability issues, such as environmental pollution, limited water availability, and an increasing population and waste products [43].

Some of the innovative ideas, such as infrared thermal imaging and the aquaponics, can be costly and not always practical, but could contribute to the main aim in sustaining the environment in informal settlements if managed effectively and should be considered.

In addition, children should learn about the dangers of pollution and how it could impact on their health and wellbeing. The following ideas can be applied to teach them: make colourful illustrative posters with pictures showing them the dangers of pollution for humans, animals and the environment; convey information in the form of storytelling, drama and puppet shows for old and young to teach them how to sustain the environment and avoid diseases caused by land pollution and other health risks; teach children living in these settlements songs and dances that they can sing while cleaning up the environment; while teaching the children, encourage them to also teach their parents at home to take care of waste and not to dump waste in the road or river; encourage children and adults to use drawings and paintings on informal settlement houses for teaching others how to avoid pollution and keep the environment safe (this could also contribute to a more colourful settlement).

Lastly, Meier and Sisk-Hilton [10] emphasise the importance of pursuing environmental education and the teachers’ essential role in redesigning and implementing curricula, which include a compulsory subject on how to sustain the environment. However, education is a complex system, and the quality and success of education and innovative projects will largely depend on the Government and the Department of Basic Education’s strategic plan to ensure sufficient financial support is provided and all citizens receive relevant education in how to sustain the environment effectively.
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References
1. Niva, V.; Taka, M.; Varis, O. Rural-Urban Migration and the Growth of Informal Settlements: A Socio-Ecological System Conceptualization with Insights. Through a “Water Lens”. Sustainability 2019, 11, 3487. [CrossRef]
2. United Nations. Department of Economic and Social Affairs. World Population Prospects 2019: Highlights. 2019. Available online: https://population.un.org/wpp/Publications/Files/WPP2019_Highlights.pdf (accessed on 22 January 2021).
3. Lyu, H.; Dong, Z.; Roobavannan, M.; Kandasamy, J.; Pande, S. Rural Unemployment Pushes Migrants to Urban Areas in Jiangsu Province, China. Palgrave Commun. 2019, 5, 92. [CrossRef]
4. Statistics South Africa. Measuring the Progress of Development in South Africa. 2020. Available online: http://www.statssa.gov.za/?p=13908 (accessed on 12 December 2020).
5. Nassar, D.M.; Elsayed, H.G. From Informal Settlements to Sustainable Communities. Alex. Eng. J. 2018, 57, 2367–2376. [CrossRef]
6. Säumel, I.; Reddy, S.E.; Wachtel, T. Edible City Solutions—One Step Further to Foster Social Resilience through Enhanced Socio-Cultural Ecosystem Services in Cities. Sustainability 2019, 11, 972. [CrossRef]
7. Hamann, R.; April, K. On the Role and Capabilities of Collaborative Intermediary Organisations in Urban Sustainability Transitions. J. Clean. Prod. 2013, 50, 12–21. [CrossRef]
8. McKeown, R. Environment Society Economy Education for Sustainable Development Toolkit Version 2. 2002. Available online: http://www.esdtoolkit.org.
9. Huchzermeyer, M. Pounding at the Tip of the Iceberg: The Dominant Politics of Informal Settlement Eradication in South Africa. Politikon 2010, 37, 129–148. [CrossRef]
10. Meier, D.; Sisk-Hilton, S. Nature and Educational Environment in Early Childhood. New Educ. 2017, 13, 191–194. [CrossRef]
11. Siraj-Blatchford, I.; Taggart, B.; Sylva, K.; Sammons, P.; Melhuish, E. Towards the Transformation of Practice in Early Education: The Effective Provision of Preschool Education (EPPE) project. Camb. J. Educ. 2008, 38, 23–36. [CrossRef]
12. Pramling, N.; Doverborg, E.; Samuelsson, I.P. Re-metaphorizing Teaching and Learning in Early Childhood Education beyond the Instruction—Social Fostering Divide. In Nordic Social Pedagogical Approach to Early Years; Ringsmose, C., Kragh-Müller, G., Eds.; Springer: Dordrecht, The Netherlands, 2017; Volume 15, pp. 205–218. [CrossRef]
13. United Nations (UN). The Sustainable Development Goals Report 2016; United Nations: New York, NY, USA, 2016. Available online: https://unsdsn.un.org/sdgreport/2016/ (accessed on 13 December 2020).
14. Engdahl, I. Early Childhood Education for Sustainability: The OMEP World Project. Int. J. Early Child. 2015, 47, 347–366. [CrossRef]
15. Ceka, A.; Murati, R. The Role of Parents in the Education of Children. J. Educ. Pract. 2016, 7, 61–64.
16. Damereill, P.; Howe, C.; Milner-Gulland, E.J. Child-Orientated Environmental Education Influences Adult Knowledge and Household Behaviour. Environ. Res. Lett. 2013, 8, 015016. [CrossRef]
17. Inglehart, R.; Haerpfer, C.; Moreno, A.; Welzel, C.; Kizilova, K.; Diez-Medrano; Lagos, M.; Norris, P.; Ponarin, E.; Puranen, B. World Values Survey: Round Six—Country-Pooled Datafile Version. 2014. Available online: www.worldvaluessurvey.org/WVSDocumentationWV6.jsp (accessed on 23 January 2021).
18. Zanganeh, M.; Varesi, H.R.; Zangiabadi, A. Strategic Housing Planning through Sustainable Development Approach in Iran Metropolitans: Case Study of Metropolitan Mashhad. J. Basic Appl. Sci. Res. 2013, 3, 180–188.
19. Brown, A. Claiming the Streets: Property Rights and Legal Empowerment in the Urban Informal Economy. World Dev. 2015, 76, 238–248. [CrossRef]
20. Statistics South Africa. General Household Survey. 2016. Available online: http://www.statssa.gov.za/?p=9922 (accessed on 20 December 2020).
21. National Department of Housing. White Paper: A New Housing Policy and Strategy for South Africa. 2004. Available online: http://www.dhs.gov.za/sites/default/files/legislation/Policies_Housing_White_Paper.pdf (accessed on 17 December 2020).
22. Sepuru, D. Informal Settlement Upgrading in the Current Policy Context: Lessons from the Civic Movement in Lebowakgomo in Limpopo Province, 1990–2000. Ph.D. Thesis, University of the Witwatersrand, Johannesburg, South Africa, 2009.
23. Giddings, B. The Role of Urban Design in Developing Communities. In Proceedings of the CIB World Building Congress, Cape Town, South Africa, 14–17 May 2007. Available online: http://nrl.northumbria.ac.uk/policies.html (accessed on 24 January 2021).
24. Republic of South Africa. Constitution of the Republic of South Africa No. 108 of 1996. Available online: https://www.gov.za/sites/default/files/images/a108-96.pdf (accessed on 2 February 2021).
25. Du Plessis, A.A. The “Brown” Environmental Agenda and the Constitutional Duties of Local Government in South Africa: A Conceptual Introduction. Potchefstroom Electron. Law J. 2015, 18, 1846–1880. [CrossRef]

26. Adlard, G. Poverty, Urbanisation and Informal Settlements in Cape Town: A Handbook for Local Government Policymakers and Practitioners. 2010. Available online: https://www.westerncape.gov.za/text/2005/1/informal_settlements_handbook_compressed.pdf (accessed on 11 February 2021).

27. Huchzermeyer, M. A Legacy of Control? The Capital Subsidy and Informal Settlement Intervention in South Africa. Int. J. Urban Reg. Res. 2003, 27, 591–612. [CrossRef]

28. Republic of South Africa. Breaking New Ground: A Comprehensive Plan for the Development of Integrated Sustainable Human Settlements. 2004. Available online: http://www.dhs.gov.za/sites/default/files/documents/26082014_BNG2004.pdf (accessed on 4 January 2021).

29. Shirvani-Dastgerdi, A.; De-Luca, G. Boosting City Image for Creation of a Certain City Brand. Geogr. Pannonica 2019, 23, 23–31. [CrossRef]

30. Lombard, M. Constructing Ordinary Places: Place-making in Urban Informal Settlements in Mexico. Progress in Planning. Prog. Plan. 2013, 94, 1–53. [CrossRef]

31. Mathee, A. Environment and Health in South Africa: Gains, Losses, and Opportunities. J. Public Health Policy 2011, 32, 37–43. [CrossRef] [PubMed]

32. Ali, S.; Khan, A. Lahore—A City of Slums and Shanties. Daily Times. 27 October 2017. Available online: https://dailytimes.com.pk/131048/lahore-city-slums-shanties (accessed on 14 November 2020).

33. Debrah, J.K.; Vidal, D.G.; Dinis, M.A.P. Innovative Use of Plastic for a Clean and Sustainable Environmental Management: Learning Cases from Ghana, Africa. Int. J. Urban Sci. 2021, 5, 12. [CrossRef]

34. De Jager, T.A. Proposal to Integrate the Management of Electronic Waste into the Curriculum of Primary Schools. EURASIA J. Math. Sci. Tech. Ed. 2015, 11, 443–454. [CrossRef]

35. Perkins, D.N.; Drisse, M.B.; Nxele, T.; Sly, P.D. E-Waste: A Global Hazard. Ann. Glob. Health 2018, 80, 286–295. [CrossRef] [PubMed]

36. Seymore, V. The Human–Nature Relationship and its Impact on Health: A Critical Review. Front. Public Health 2016, 4, 260–272. [CrossRef] [PubMed]

37. Bronfenbrenner, U. The Ecology of Cognitive Development: Research Models and Fugitive Findings. In Development in Context: Acting and Thinking in Specific Environments; Wozniak, R.H., Fischer, K., Eds.; Psychology Press: New York, NY, USA, 1993; pp. 3–44.

38. Kohlberg, L. Stages and Aging in Moral Development: Some Speculations. Gerontologist 1973, 13, 497–502. [CrossRef]

39. Zhu, W.; Chen, H.; Ciechanowska, I.; Spaner, D. Application of Infrared Thermal Imaging for the Rapid Diagnosis of Crop Disease. IFAC-PapersOnLine 2018, 51, 424–430. [CrossRef]

40. Bailey, D.S.; Ferrarezi, R.S. Valuation of Vegetable Crops Produced in the UVI Commercial Aquaponic System. Aquac. Rep. 2017, 7, 77–82. [CrossRef]

41. Palm, H.W.; Seidemann, R.; Wehofer, S.; Knaus, U. Significant Factors Influencing the Economic Sustainability of Closed Aquaponic Systems. Part I: System Design, Chemo-Physical Parameters and General Aspects. Aquac. Aquar. Conserv. Legis. 2014, 7, 20–32.

42. Govender, T.; Barnes, J.M.; Pieper, C.H. Contribution of Water Pollution from Inadequate Sanitation and Housing Quality to Diarrheal Disease in Low-Cost Housing Settlements of Cape Town, South Africa. Am. J. Public Health 2011, 101, e4–e9. [CrossRef] [PubMed]

43. Sasol. Annual Integrated Report 30 June 2014. Available online: https://www.sasol.com/financial-reports/annual-integrated-report-30-june-2014 (accessed on 5 January 2021).