Exploring University-Community Engagement by Pre-Service Science Teachers through the Study of a Biology Module

By

Oluwakemi Ayodeji Adebayo

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Supervisor: Prof. Ronicka Mudaly

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ABSTRACT

The emphasis of university community engagement (UCE) by universities in South Africa and many parts of the world has been the collaboration between the host universities and their surrounding local and regional neighbours. This study explored university-community engagement (U-CE) by pre-service science teachers through the study of a biology module that interacted with the 'student community' that resided in the university campus residence. Globally, the lack of adequate nutrition among university students shows the prevalence of poverty affecting the student population. Literature is scarce on the issues of well-being and food insecurity among students who reside in university campus residences in South Africa.

The study was located in the critical paradigm with the aim of exploring critical pedagogy of conscience for pre-service science teachers linked with emancipation and transformation of the students with low socioeconomic status and who form the student community. Insights from Rasmussen (1996) about the propensity of critical theory to bring about transformation informed this study. Views about critical pedagogy, which relates to precise situations, students and groups, as proffered by Giroux (2011) were central to the design of the study as well as its implementation and consequent theoretical insights that were generated.

The research was a qualitative case study. The participants in this study were thirty-six pre-service science teachers who were offered a module called Biological Sciences for Educators 310 (EDBS 310) and twelve pre-service teachers residing in the campus residences who did not offer EDBS 310 module. Convenience and purposive sampling techniques were used to select the participants. The methods of data collection included focus group interviews, individual interviews, reflective journals and students' portfolios of evidence. The pre-service science teacher participants cultivated food gardens for 10-12 weeks in groups of six.

The findings that emerged from this research indicated that the implementation of U-CE requires adequate planning, preparation, and teamwork among pre-service science teachers. Also, the effective U-CE entails a collaboration between students and the university management while U-CE has the potential to positively improve the nutritional and social well-being of students who reside in a university campus

residence. Moreover, engaging in U-CE can raise the consciousness of pre-service science teachers towards attaining professional identity for their future practice. Hence, U-CE can facilitate the process of being a teacher to becoming a teacher. A pedagogy of conscience is argued for.

The conclusion and the recommendations from this study include ensuring the democratic collaboration among pre-service science teachers undertaking U-CE and the development of a well-defined blueprint for U-CE by the university management for community engagement programmes. Finally, the government and the curriculum developers should make a serious consideration into exploring the positive impact of U-CE on pre-service science teachers' wellbeing and identity for their future practice.

Keywords: University-community engagement (U-CE), critical pedagogy, transformation, consciousness, pre-service teachers, pedagogy of conscience.

DECLARATION

I, Oluwakemi Ayodeji Adebayo declare that:

(i) The research reported in this thesis, except where otherwise indicated, is my original work.

(ii) This thesis has not been submitted for any degree or examination at any other university.

(iii) This thesis does not contain other persons' data, pictures, graphs or other information unless specifically acknowledged as being sourced from other persons.

(iv) This thesis does not contain other persons' writing unless specifically acknowledged as being sourced from other researchers. Where other written sources have been quoted, then:

a) Their words have been re-written, but the general information attributed to them has been acknowledged; and

b) Where their exact words have been used, their writing has been placed within quotation marks, and referenced.

(v) The work described in this thesis was carried out in the School of Education, University of KwaZulu-Natal, from July 2015 to November 2019 under the supervision of Prof. R. Mudaly (Supervisor).

(vi) Ethical clearance No. HSS/0883/016D was granted prior to undertaking the fieldwork.

Signed: _____ Date: _____

As the candidate's supervisor I, Prof. Ronicka Mudaly, agree to the submission of this thesis.

Signed: _____ Date: _____

ETHICAL CLEARANCE CERTIFICATE

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

08 July 2016

Mr Oluwakemi Ayodeji Adebayo (214581977)
School of Education
Edgewood Campus

Dear Mr Adebayo,

Protocol reference number: HSS/0883/016D
Project title: Exploring university community engagement by pre-service science teachers through the study of Biology module at a South African university

Full Approval – Expedited Application

With regards to your response received on 04 July 2016 to our letter of 22 June 2016. The documents submitted have been accepted by the Humanities & Social Sciences Research Ethics Committee and **FULL APPROVAL** for the protocol has been granted.

Any alteration/s to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through the amendment/modification prior to its implementation. In case you have further queries, please quote the above reference number.

Please note: Research data should be securely stored in the discipline/department for a period of 5 years.

The ethical clearance certificate is only valid for a period of 3 years from the date of issue. Thereafter Recertification must be applied for on an annual basis.

I take this opportunity of wishing you everything of the best with your study.

Yours faithfully

.....
Dr Shenuka Singh (Chair)

/ms

cc Supervisor: Dr Ronicka Mudaly
cc Academic Leader Research: Dr SB Khoza
cc School Administrator: Ms Tyzer Khumalo

Humanities & Social Sciences Research Ethics Committee
Dr Shenuka Singh (Chair)
Westville Campus, Govan Mbeki Building
Postal Address: Private Bag X54001, Durban 4000
Telephone: +27 (0) 31 260 3587/8350/4557 **Facsimile:** +27 (0) 31 260 4609 **Email:** simbanp@ukzn.ac.za / anymanim@ukzn.ac.za / mohunp@ukzn.ac.za
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Finally, I sincerely thank my participants for making the time to be part of my study. I am grateful for all your contributions to the research.

DEDICATION

This thesis is dedicated to my mother, Mrs. Jemimah Abidogun, my wife, Ronke and my sons, Ayoola and David.

GLOSSARY OF ACRONYMS AND ABBREVIATIONS

CE	Community Engagement
EDBS 310	Education for Biological Sciences 310
HEI	Higher Education Institution
IK	Indigenous Knowledge
IKS	Indigenous Knowledge System
NBPST	Non-biology pre-service teacher
PSST	Pre-service science teacher
PST	Pre-service teacher
UCE	University Community Engagement (University collaboration with the neighbouring or regional communities)
U-CE	University-Community Engagement (University collaboration with students who are part of the university community)

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CHAPTER 1: ORIENTATION OF THE STUDY

1.1 Introduction and background

Carnegie's Community Engagement Classification, according to Driscoll (2008, p. 39), defined “community engagement” as “the collaboration between institutions of higher education and their larger communities (local, regional/state, national, global) for the mutually beneficial exchange of knowledge and resources in a context of partnership and reciprocity.” The Council on Higher Education (2004, p. 17) of South Africa, in its Higher Education Quality Committee’s Institutional Audit Framework, defined Community Engagement as follows:

> Initiatives and processes through which the expertise of the institution in the areas of teaching and research are applied to address issues relevant to its community. Community engagement typically finds expression in a variety of forms, ranging from informal and relatively unstructured activities to formal and structured academic programmes addressed at particular community needs (service-learning programmes).

Community engagement (CE), by the universities, is one of the three fundamental functions of the universities in South Africa and around the world, in addition to research and teaching (De Rassenfosse & Williams, 2015; Network, 2005; Nkoana & Dichaba, 2017; Paphitis & Kelland, 2016; van Schalkwyk, 2015). The importance of CE and its impact on the surrounding communities near the universities has been widely researched, including its achievements and shortfalls (Le Clus, 2012). However, a key argument of this study is that while the communities in the vicinity of the university require some services in terms of social responsibility programs and collaboration from the higher institutions of learning, students who reside on the university campus also form a ‘community’ that requires a similar engagement. This student community that requires services is at the heart of my research project and I conceptualise this as University-Community Engagement (U-CE).

Students residing in the hall of residence in a university in KwaZulu-Natal experienced challenges that affected their well-being, both nutrition-wise and health-wise, which could be associated with their historically disadvantaged socioeconomic backgrounds. Van den Berg and Raubenheimer (2015) asserted that food insecurity among students in South African universities may be one of the factors resulting in the failure rate of 50% of students in the institutions of higher learning. The students, according to the author, do not have access to an adequate and wholesome food supply. Some universities such as the University of the Free State (UFS) and University of Johannesburg (UJ) have been organising feeding programs called “no student hungry” and “Meal Assistance Programme” respectively to alleviate the predicament of food insecurity on their campuses (Lewin & Mawoyo, 2014, p. 46).

The focus of this study is two-pronged. Firstly, the study aims to challenge the conventional teaching and learning process of a biology module by using the U-CE project, almost solely designed and controlled by pre-service science teachers. Secondly, the study intends to interrogate pre-service science teachers’ (PSSTs) and non-biology pre-service teachers’ (NBPSTs) views about the influence of U-CE project on the lives of students residing in the university campus residence, with certain health and nutritional issues as well as the professional identity of PSSTs for their future practice.

The participants in this study were drawn from the 2017 stream of students who registered for Biological Science for Educators 310 (EDBS 310) module in the university under study. There were 36 pre-service science (biology) teachers who volunteered to participate in the study who were selected, while 12 non-biology pre-service teachers, who self-classified as coming from low socioeconomic backgrounds, also participated. The PSSTs participants undertook a U-CE project on food gardening where the participants visited an eco-school, did research on students’ health needs and cultivated the gardens, in groups of six members each for 8-12 weeks.

Several students who attend the universities prefer to live in the university’s campus residence in South Africa (Higher Education Authority, 2017). Within these settings, food insecurity among students has been recorded (Kassier & Veldman, 2013). One outcome of university students not consuming an adequate diet in the university is low self-esteem, which has been confirmed by researchers (Hughes, Serebryanikova,

Donaldson, & Leveritt, 2011). Scholars also discovered that food insecurity is associated with university students who reside in campus residences or off-campus and share rooms with peers (Chaparro, Zaghloul, Holck, & Dobbs, 2009; Hughes et al., 2011). More so, numerous ill-health conditions such as malnutrition, violent behaviour, emotional imbalance, and obesity, have been caused by food insecurity (Coleman-Jensen, Gregory, & Singh, 2014; Pan, Sherry, Njai, & Blanck, 2012; Seligman, Laraia, & Kushel, 2009).

In a study conducted by Goldrick-Rab, Richardson, Schneider, Hernandez, and Cady (2018) in the United States of America, the following was revealed:

> During the 30 days preceding the survey, 42% of community college students indicated that they were at the lowest or very lowest levels of food security. Moreover, 36% of university students were at those levels. Almost one-third of community college students and one-quarter of university students said that because of a lack of money they skipped meals or cut the size of their meals, with 22% of community college students and 18% of university students doing this at least 3 days in the last 30 days

Furthermore, a study conducted by Gwacela (2013) with 511 first-year students who were at the risk of academic exclusion due to poor academic performance at the University of KwaZulu-Natal, revealed that 55% of these students were food insecure and from the low socioeconomic background. It was further discovered that many of the student participants, who were receiving bursaries, used a part of their funding to support their families at home because their parents or guardians were unemployed and relied on a paltry sum in the form of social grants from the South African government.

In contextualizing the challenges of hunger, poor well-being, the vulnerability of students and food insecurity in the South African context, it was found that the many historically disadvantaged students suffer more from these problems because they are less privileged due largely to their low socioeconomic status (Devereux, 2018; Michael et al., 2018).

1.2 Purpose and focus of this study

The purpose of this study is to explore university-community engagement by pre-service science teachers through the study of a biology module. The focus of this study is to explore how a university-community engagement (U-CE) project can influence the well-being of both pre-service science teachers (PSSTs) implementing the program and another group of non-biology pre-service teachers (NBPSTs), who did not study biology, and who resided in a university campus residence.

The literature revealed that researchers have scrutinized the benefits of service-learning vis a vis community engagement with the surrounding communities outside of the university environment (Hebert & Hauf, 2015; Tobin, Donnelly, Graham, & Tarsi, 2016). However, there is a 'community' within the university community that requires an engagement that can benefit from the community engagement projects by the students of the same university. This community represents the residential community of the university community. In my study, I focused on students in the university, and referred to this as the "university community". I use the term "university-community-engagement" (U-CE) to refer to service to students by students, in a process that is designed to make students more conscious in respect of food security and healthy living.

A biology module called Biological Science for Educators 310 (EDBS 310) was selected to be used for this research. This biology module was offered to pre-service science students in the first semester of their 3rd year during 2017. More so, the aim of the module was to develop appropriate knowledge, skills, values, and attitudes with regard to processes in living organisms. The content of the module covered topics including Nutrition, Reproduction, Transport, and Respiratory systems. A topic called 'Nutrition' was carefully chosen to be used for preparing a food garden project in this research. Furthermore, the way through which U-CE can be effectively implemented, the requirements for functioning U-CE, the influence of U-CE on the well-being of pre-service teachers (PSSTs and NBPSTs) and the impact of U-CE on the professional identity of PSSTs and their future practice, were investigated.

This study challenges the 'technicist' nature of the delivery of content in the curriculum to the students in the university environment, a traditional method where students are

taught to be programmed only for the workplace was contested. “Universities should be about more than developing work skills. They must also be about producing civic-minded and critically engaged citizens” (Giroux, 2013b).

1.3 Location of the study

This study was conducted in one of the four public universities in the KwaZulu-Natal province of South Africa. The KwaZulu-Natal province has two universities offering general courses including education programs while the other two universities specialize in the courses related to Technology without offering education degrees. The former includes the University of KwaZulu-Natal (UKZN) and the University of Zululand (UNIZULU) while the latter includes the Durban University of Technology (DUT) and Mangosuthu University of Technology (MUT) respectively. The study was in one of the two universities that graduate students in education degrees, both at undergraduate and postgraduate levels.

1.4 Rationale for the study

The rationale for this study is based on three-prong concerns which are as follows: firstly, my direct personal experience as a postgraduate student living in university student accommodation for five years has made me privy to how students struggle to obtain food. Secondly, my experience as a student housing staff member who managed over 1400 students in different campus residences and having had first-hand information about health-related and living conditions of students. Thirdly, my observation (as a contract tutor) of many pre-service biology teachers during their annual Teaching Practice program who did not design the teaching of biology lessons to challenge the status quo of the background of their learners from Quintile 1, 2 and 3 schools. In South Africa, Quintile 1, 2 and 3 schools are the schools located in the poorest and economically disadvantaged areas in the country and they are no fee-paying schools (Hall & Giese, 2009; Ogbonnaya & Awuah, 2019). “Approximately 86% of all public ordinary schools nationally are no-fee schools and approximately 79% of all learners are accommodated in no-fee schools nationally” in South Africa (Department of Basic Education, 2017, p. 10). My experience, based on my observation of pre-service teachers on Teaching Practice, revealed a disconnect between their civic responsibilities, teacher identity, and practice. Therefore, my view

is that pre-service teacher engagement in the service of the university community, and the effect of this on their professional identity, is worthy of scholarly inquiry.

1.5 Significance of the study

This study contributes to the theorization of how university-community engagement (U-CE) can be used to assist pre-service teachers to transcend the boundaries of what they believe they can do, and to become agents of change/emancipation within the university community. This study has the potential to stimulate teacher education curriculum experts to relook the structure of the science education curriculum to strengthen it, by making it responsive to the context of the university students. Finally, the study proposes a model that will add to the discourse of critical pedagogy.

1.6 Limitations of the study

This case study was conducted in only one university providing education qualifications for students in the KwaZulu-Natal province of South Africa and thus the findings cannot be generalized to any other higher education institution offering similar qualifications.

1.7 Research aims

1. To explore how pre-service science teachers implement university-community engagement through their study of a Biology module.

2. To examine pre-service science teachers' views about requirements for effective university-community engagement through a Biology module.

3. To determine pre-service science teachers' views about how university-community engagement can influence the well-being of students at a university.

4. To assess how engaging in a university community-engagement project influences pre-service science teachers' professional identity for their future practice.

1.8 Research questions

Research Question One:

How do pre-service science teachers implement university-community engagement through their study of a Biology module?

Research Question Two:

What are pre-service science teachers' views about requirements for effective university-community engagement through a Biology module?

Research Question Three:

What are pre-service science teachers' views about how university-community engagement can influence the well-being of students at a university?

Research Question Four:

How does engaging in a university-community engagement project influence pre-service science teachers' professional identity for their future practice?

1.9 Research design

A qualitative case study approach was used to engage 36 PSSTs and 12 NBPSTs to explore university-community engagement (U-CE) by pre-service science teachers through the study of a biology module in a university in KwaZulu-Natal. The study was located within the critical paradigm. The critical paradigm was used because I researched the transformation in the pedagogical process of teaching biology. Besides, multiple sources of data were used to understand the phenomenon. The data were gathered through focus group interviews, individual interviews, portfolios of evidence and reflective journals. The purpose of using multiple sources of data was to triangulate methods, thereby increasing the trustworthiness of the study.

1.10 Findings

It emerged from this research that the student community members (pre-service teachers) who participated in this study became critically aware of how to make sustainable gardens including the use of indigenous methods. Their awareness of healthy diets, reduction of hunger and poverty, through the development of sustainable

food gardens, was heightened. The pre-service science teachers were influenced in their professional identity and vision for future practice as teachers. The findings are summarised as follows: 1. Implementation of U-CE requires adequate planning, preparation, and teamwork among pre-service science teachers, 2. Effective U-CE entails a collaboration between students and the university management, 3. U-CE has the potential to positively improve the nutritional and social well-being of students who reside in a university campus residence and 4. Engaging in U-CE can raise the consciousness of PSSTs towards attaining professional identity for their future practice

1.11 Overview of chapters

Chapter one of this study provided the setting for this research where the purpose, focus, rationale and significance of this work is applicable to the South African education system and its society. Also outlined are the research aims and questions that guided this study. Moreover, a summary of the research design and findings were elucidated. Based on the synthesis of the findings, a pedagogy of conscience is argued for.

Chapter two discusses the literature based on research, in both local and international settings, and how it relates to my study which explored university-community engagement by pre-service science teachers. The literature was used to describe and explain the university community engagement (UCE) commonly practiced by universities. It further revealed the challenges that student communities experience on university campuses, such as health matters and food insecurity. The significance of indigenous knowledge and arguments for a U-CE that is critical were examined. Finally, the theoretical framework, the critical theory, with the emphasis on critical pedagogy, was explained.

Chapter three details the research methodology adopted for this study. A qualitative approach was used with a critical paradigm to analyse and interpret the data generated from the study. The design used was a case study and data collection was made using several sources, namely, focus group interviews, individual interviews, reflective journals and portfolios of evidence. The justification for content analysis, rigour of the study, ethical considerations, and limitations in respect of the study were also presented in this chapter.

Chapter four is concerned with the analysis and presentation of the data using extant literature. Data that emerged from the insights of the participants from the focus interviews, individual interviews, reflective journals and the portfolios of evidence were coded, categorized and organized into themes.

Chapter five provides a deeper level of analysis using the works of the critical pedagogues such as Paulo Freire, Henry A. Giroux, Ira Shor, Rodolfo D. Torres, Peter McLaren, Maxine Greene, Joe L Kincheloe, Maria Nikolakaki and Stanley Aronowitz, and a host of others to understand the themes that emerged. A critical model for U-CE was developed in this chapter to contribute to the theory of the phenomenon using critical perspectives.

Chapter five sums up the key findings of the study. The contribution of this investigation to the body of knowledge was elucidated. Additionally, the recommendations that emerged based on the findings of this study were outlined.

1.12 Conclusion

This chapter provided the introduction and background upon which this study was established. It further explained the purpose, focus, rationale and significance of the research. The research aims, which informed the research questions, were outlined. A summary of the methodology was described, and the highlights of the chapters in the thesis were explicated. The next chapter will delve into the literature that was reviewed as it relates to the focus of the study.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

This chapter examines the works of scholars, both locally and internationally, as they relate to the university-community engagement (U-CE) by pre-service science teachers through the study of a biology module. In my study, I focused on students in the university, and refer to this as the "university community". I used the term "university-community engagement" or U-CE, to refer to service to students in residence by students, in a process that is designed to make students more conscious of their health issues, food security, and teacher identity.

The literature review comprises the following: Firstly, the concept of university community engagement (UCE) in universities and how UCE was implemented, was examined. Secondly, researchers' work on issues confronting students' community in the local and international universities, especially undergraduate students residing on the university campuses, was scrutinized. Thirdly, the need for a pedagogy that responds to pre-service teachers' community as it relates to their well-being, food security, identity, and preparation for future professional practice was appraised. Fourthly the theoretical framework, which is critical pedagogy, which was adopted for this study, was reviewed.

2.2 University Community Engagement (UCE)

2.2.1 Community

The definitions of the term 'community' have been hotly contested during the last three decades. A reflection of the ontological and epistemological considerations of the nomenclature 'community' enables me to appreciate scholars' contributions to the concept. Hillery (1955) studied 94 definitions of 'community' and inferred that a community comprises a group of individuals who relate together, share one or more connections in common and stay in a place. The following Table 1 displays the emphases the 94 researchers highlighted when they were analysed by Hillery (1955).

Table 1: "A classification of selected definitions of community according to content" between 1912 and 1950

Adapted from (Hillery, 1955, pp. 114-115)

Distinguishing ideas or elements mentioned in the definitions	Number of definitions	Authors
I. Generic Community:		
• Social Interaction		
• Geographic area		
1. Self-sufficiency…….	8	Wilson; Hobhouse, Wheeler, & Ginsberg; Sanderson; Zimmerman; Fairchild; Davis; Landis; Hawley
2. Common Life…….	9	Maclver; Maclver & Page; Morse; Park & Burges; Kinneman; Snedden; McClenahan; Zorbaugh; Wirth; Bernard
(1) Kinship…….	2	Tönnies; Heberie
3. consciousness of kind…	7	Jackson; Gillette; Brunner; Lindeman; Cook; Nelson; Anderson & Hill
4. possession of common ends, norms, means……	20	Ward; Hieronymus; North; Dunn; Pirenne; Lundquist & Carver; Wood; Lundquist & Moore; Burr; Steiner; North; Osburn & Neumeyer; Gettys; Ginsberg; Panunzio; Hoffsommer &Pryor; Homans; Hiller; Bennett & Tumin; Hillman
e. collection of institutions……	2	Park; Ogburn & Nimkoff
f. locality groups…….	5	Galpin; Burgess; Rich; Sanders & Ensminger; Warner
g. individuality…….	2	Howe; McKenzie
• Presence of some common characteristic, other than area		
a. self-sufficiency……	1	Butterfield
b. common life……...	3	Small; Sims; Park
c. consciousness of kind……	5	Cooley, Cole; Differdorfer; Allport; Hayes
d. possession of common ends, norms, means……	5	Russell; Pettit; Panunzio; Morgan; J. & J. Ogden
• Social system……	1	Hill & Whiting
	3	Hart; Liao; Bews
• Individuality……	1	Fairchild
	2	Follett; Case
• Totality of Attitudes……	3	McKenzie; Hughes; Hollingshead
• Process…….		
• Ecological Relationships……	1	Gillette
II. Rural Community:	3	Henderson; McClenahan; Sorokin, Zimmerman, & Galpin
• Social Interaction		
1. Geographic area	3	Thompson; Ensminger; T.L. Smith
a. self-sufficiency……		
b. common life……	3	Burr; Lantis; Sanderson
		Wilson; Galpin; Vogt; Sanderson; Kolb & Marshall

c. consciousness of kind……...	5	
d. possession of common ends, norms, means…….	**94**	……..
5. locality group		
Total Definitions……		

From Table 1, the definitions of the term ‘community’ identified social exchanges, geographical area and common rules associated with the members of the group as characteristics peculiar to a ‘community’. These classifications, according to Table 1 indicated how the community should be organized. In addition, Rifkin, Muller, and Bichmann (1988, p. 933) described the community as “a group of people living in the same defined area sharing the same basic values, organization, and interests”. Accordingly, a typical ‘student community’ found on the university campus possesses social interactions, located in the campus residence and is guided by the rules and regulations as laid down by the higher institution of learning with inputs from the student representative council. Trowler and Trowler (2010) examined scholars’ work on students’ interaction with structures of the universities and stressed the importance of the relationship to bolster the governance of the universities by the institutions’ authorities. Parts of the objectives of student representatives in universities in South Africa are to engage and collaborate with the universities’ guidelines in ensuring transformation and citizenship of the student body (Rhodes University, 2001; University of Free State, 2018a; University of KwaZulu-Natal, 2018). The involvement of student representatives in improving the university rules and regulations indicates inclusivity in the running of the universities in South Africa. The significant influence of students’ representation has been underscored by Klemenčič, Luescher, and Jowi (2015, p. viii) who confirmed that:

> “Student representation is a widespread phenomenon, worldwide and across all African higher education institutions, at the level of institutional governing bodies. Indeed, it is a vital ingredient in higher education governance at the institutional level that is, the decision-making processes, structures and relationships through which higher education institutions choose their goals and guide and restrain collective activities”

Thus, through a variety of structures, university students form the student body, a key segment of the university community that makes its voice heard by the university authority which exemplifies a social interaction, in a geographical area and is guided by rules and regulations.

Modern-day definitions of the word ‘community’ have corroborated the historical definitions analysed by Hillery (1955) as mentioned in the preceding paragraphs. Scholars have also debated that a concise description of the term ‘community’ has not been agreed upon by researchers. According to Klevesath and Reese-Schäfer (2016, p. 171), experts in social science believed that “the term community refers to a group of interacting individuals whose social relations are bound up by shared meanings and shared values”. “Community can, and does, mean anything from a university’s own staff and students and a community of practice to civic organisations, schools, townships, citizens at large and ‘the people’ in general” (Council on Higher Education, 2010, p. 2). Noting the definition of the Council on Higher Education (2010) of South Africa in the preceding sentence, I argue that research by the universities considering ‘students’ as a ‘community’ when planning and implementing university-community engagement (U-CE) is scarce, based on my search of the literature using EBSCOhost, Google scholars, ERIC and iCatalogue (UKZN from library) search engines.. This observation makes my study important because it explored university-community engagement (U-CE) by pre-service science teachers through the study of a biology module whose focus is on the ‘student community’ that resided in the university campus accommodation vis-à-vis the community engagement procedure of pre-service science teachers.

It should be noted that in this study, the acronym ‘UCE’ represents the university community engagement that involves a partnership between the universities and its host or regional communities while the ‘U-CE’ is the university community engagement that I propose should exist between the university and the ‘student community’ that reside on the university campus residence.

2.2.2 Conventional University Community Engagement (UCE) in the universities

Historically, the role of universities in society has been contested by many academics. According to McKenna (2013, p. 1) “there is not even consensus as to whether a

university education is for the elite or the masses, serves social development or economic growth, is a private good or a public one". The view of McKenna (2013) is corroborated by Nnadozie (2018) who alluded to the fact that the existence of the contemporary university for more than 800 years has not materialized into a unified position among scholars as to what is the vision for the institution of higher learning. Three prominent descriptions are advanced as encompassing the role of universities which are "the liberal theory, the professional formation theory and research engine" (Watson, Hollister, Stroud, & Babcock, 2011, p. 13). The authors explained that liberal theory encourages individuals to be self-conscious through striving for merits in society. The professional formation theory classifies universities as higher institutions that provide career and specialized skills to students while the research engine function recognizes the goal of the university's region and country by supporting its fiscal growth and development. However, there is a growing sense of commitment by universities around the world to serve and engage with their host communities and constituencies. Through community engagement, universities can contribute to the social renewal and economic growth of the localities in their domains (Council on Higher Education, 2016c; Mtawa, Fongwa, & Wangenge-Ouma, 2016; Onwuemele, 2018; The University of British Columbia, 2019; Wilson, Manners, & Duncan, 2014). Furthermore, institutions of higher learning can perform a crucial role in the areas where businesses are not adequately fulfilling their social responsibility duties, through research and development, to the regions in which they are located (Goddard, 2011).

Higher education institutions, both locally and internationally, have defined the term 'community engagement'. To contextualize the term, which is central to this study, some definitions are outlined:

The University of South Africa (2017 para. 5) claimed that community engagement can be defined as stated below:

> Community engagement is defined as the scholarly activity of academic research and teaching that involves external communities and stakeholders in collaborative activities that address the critical development imperatives of South Africa and the African continent while also enriching the teaching, learning and research objectives of the university. Community engagement is a reciprocal process where

> knowledge and skills are mobilized by the institution to support development imperatives, while community knowledge and agency are absorbed by the institution to create socially responsive curriculum and research.

Equally important is the definition by Professor Tabensky, Rhodes University (2018, p. 7) who stated that that “Community Engagement is a way of opening the doors and shattering the castle walls around the university and linking the idea of knowledge production to the idea of service for the betterment of society in a way that is consistent with the academic project.”

“Community Engagement describes the collaboration between institutions of higher education and their larger communities (local, state/regional, national, global) for the mutually beneficial exchange of knowledge and resources in a context of partnership and reciprocity” (The California State University, 2007 para 1). In a study conducted at the University of Georgia, community engagement can produce innovative models and initiatives that encompass organizational and individual actions and motivations (Farner, 2019).

The university community, according to Hall (2010), can include undergraduates, postgraduates, and people working in a university or living in an area. Hall (2010, p. 7) asserted that community engagement involves a series of programs like “service learning, problem-based teaching that addresses specific wants and needs” of the community in focus. The role of students in the higher education institutions to be socially responsible in addressing some of the socio-economic conditions in the South African context through community engagement (CE) has been emphasized (Department of Education, 2001). The National Research Foundation (2014) is committed to providing funding for research that supports community engagement from the viewpoint of higher education institutions thereby enhancing mutual benefits between the communities and the higher institutions. Preece (2013) argued that CE has become a two-way relationship rather than the previous one-way approach in which charity was the only focus. She added that Service Learning (SL) has been related to CE in South Africa and they could be combined as “Community-SL” (p. 988). Bringle and Hatcher (1996) described SL as experiential learning whereby students participate in an act of help or assistance program that provides solutions to a

community's requirements. The authors concur that SL can be used as credits for students' modules and the program also increases the intellect of students as they participate in the SL activity. SL endows the community and students benefit while experiencing the process by learning more of the course content being applied for the service program (Mouton & Wildschut, 2005).

According to the Council on Higher Education (2010), the three key obligations of institutions of higher learning are research, teaching, and CE. However, the body expresses that CE has been overlooked despite vivid policy guidelines because CE has not been engineered by the universities but by people's efforts. Waghid (1999) advocated for an intense involvement of universities in community engagement to strengthen their teaching and research capacities and, with well-designed collaborations, provide remedies to some the myriads of crises confronting South Africa. Given the preceding definitions and descriptions, it can be interpreted that the purpose of community engagement is for the universities to engage with the neighboring communities where the universities are situated. Universities implement community engagement activities with surrounding communities to alleviate some of the socio-economic challenges of the people, create partnerships, redress some of the injustices of the past through various intervention programs, to mention a few. The mutual effects of the engagements are the building of the attitudes, professional development of the students and making students appreciate the social challenges and become civic society members who will be willing to be change agents or problem solvers in the society.

2.2.3 Service-learning and biology module

In her study on pre-service teachers' professional development concerning research and SL in the University of KwaZulu-Natal, James (2010) argued that using a biology module, studied by pre-service science teachers, enhanced the professional development and social responsibility attitude of the trainee teachers. She added that through CE, the needs of the community were met and the knowledge and skills of teaching were also improved in the participants. Service-learning helps to develop compassion, resilience, enterprise, reflection on own practice and capability in pre-service teachers (Chambers & Lavery, 2012). Service-learning, as an aspect of university community engagement, has been prioritized and integrated with modules

to enhance experiential learning and citizenship among the students (University of Pretoria, 2018). More so, in Lakehead University, Canada, Harrison, Nelson, and Stroink (2013) argued that Service Learning programs and projects involving students and neighbouring communities can be a central point for the emergence of new knowledge that can address the challenge of food insecurity in the communities. This argument resonates with the focus of this study which sought to explore the use of a biology module in developing a critical pedagogical process in addressing the nutritional challenges of 'student community' that resides in a university campus. Malan, Campbell, Sibeko, Van Zyl, and Benecke, (2015) contended that service-learning had impacted an urban community plagued with high unemployment of the community members in Johannesburg, South Africa by helping to alleviate food insecurity in the area. The authors submitted that "systemic and structural change should be approached on how service-learning can be used as a means to create space for social change" (pg.1).

The use of biology modules for service learning has been found to increase students' experience with real-life situations, when they engage with the communities, increase their learning capabilities of the content of biology and skills beyond what they learn in the classrooms (Begley, 2013; Larios-Sanz, Simmons, Bagnall, & Rosell, 2011). Consequently, exploring the university-community engagement (U-CE) by pre-service teachers through the study of a biology module is intended to investigate how U-CE can be implemented, its influence on the 'student community's well-being and pre-service teachers' professional identity for future practice.

The literature which was surveyed positions university and community as separate entities. In my study, I will focus on students in the university, and will refer to this as the "university community". I will use the term "university-community engagement" to refer to service to students by students, in a process that is designed to make students aware of nutritional needs to manage health challenges and food insecurity. At this point, an argument needs to be made regarding students as a community in need of assistance from the university through CE.

2.2.4 Importance of CE on students and the communities around the universities

The need to partner with neighbouring communities to enhance mutual undertakings or increase the research that will promote the aims and objectives of a higher institution of learning is being acknowledged by universities (Leisey, Holton, & Davey, 2012). The recognition of the partnership and its contributions to university research as stated in the preceding context is essential (Bandy, 2018; Bender, 2008; Czaykowska-Higgins, 2009).

Boyle et al. (2007) discovered that field research with students, and a form of community engagement brought about a remarkable change in the attributes such as the mood and morals of the students. On the other hand, Miller (2013) agreed that community engagement fieldwork with students and the communities transforms the perceptions of the scholars from “knowing that” to “knowing how” (p. 57) leading to improving tenets and good behaviours of the students. I argue that a U-CE program involving students engaging with other students within the same university community environment can yield bilateral results for students implementing the university-community engagement and the students from the same university. Strom (2011, pp. 47-71) reflected that “collaboration, connectivity, relationships, reciprocity, embeddedness, knowledge, partnerships, networks, leadership, and communication can be built between the university and the engaged community”. In this study, I submit that collaboration, knowledge, partnership, and reciprocity could be some of the outcomes of this research that will resonate with the views of Strom (2011, pp. 47-71).

To ensure transformation and quality assurance in the institutions of higher learning in South Africa, the Higher Education Act of 1997 mandated the Council on Higher Education, the Higher Education Quality Committee (HEQC), a part of the Council on Higher Education, to examine the institutions of higher learning in the areas of teaching and learning, research and community engagement (Council on Higher Education, 2004). “Today and in the future, public universities need to build on their experience of university community relationships and transition to making engagement more central to the core of the institution” (Fitzgerald, Bruns, Sonka, Furco, & Swanson, 2016, p. 224). Thus, the value of a university engaging with communities cannot be overemphasized.

2.2.5 Criticisms of University Community Engagement (UCE)

Despite the philosophy and good intentions underpinning community engagement and its implementation, O'Meara, Sandmann, Saltmarsh, and Giles (2011) criticized the academics in higher education institutions for the wide range of undertakings being done with different outcomes in mind. The authors bemoaned the scholars for not differentiating between the nature of the engagement, (e.g. service-learning, outreach) and the objectives of the activities (e.g. enhancing the partnership with the community, improving public responsiveness). Furthermore, the duty of implementing community engagement by the South African universities has been overlooked although the task is one of the three fundamental obligations of the universities alongside the teaching and learning process and research (Council on Higher Education, 2010). The Council on Higher Education (2004) observed that universities that performed this core function, community engagement, combined it with research and teaching which emanated from the personal efforts of the members of staff and are typically performed in an inept manner instead of a purposefully organized procedure. Moreover, "Most institutions do not have formal systems for the quality assurance and monitoring of community engagement. Generally, there is little integration between research and community engagement" (Council on Higher Education, 2011, p. 10).

Hence, the imbalance of influence exists in the relationship between universities and communities, where these universities are located, which disrupts the partnership and brings about problems in community engagement projects (Dempsey, 2010). Dempsey (2010) contended that in an instance, universities may have grants to execute community engagement projects but will design the programs to involve the unpaid workforce among the members of the communities that participate in the exercise. This could imply the misappropriation of the grant. Kearney (2015, p. 26) alluded to "community perceptions based on mistrust". The author discovered that community members perceived university community engagement as benefiting the universities who initiated the program to obtain funding for these projects without meeting the needs of the community.

Zeelen (2012, p.157) examined the implementation of university community engagement in African countries such as South Africa, Uganda, Tanzania, Mozambique, and Ghana and concluded that the system was "highly dysfunctional,

especially in terms of wasted human capacity as well as financial resources". The author suggested that that the responsibilities of a university concerning the generation of relevant new knowledge, preparing students adequately as active citizens for the challenges in the labour market, contributing to the development of communities, and fostering critical thinking need to be given high priority.

According to Nkoana and Dichaba (2017), research conducted at the University of South Africa (UNISA) indicates that inadequately preconceived university community engagement has a negative effect on its implementation leading to the poor outcome of the process. Appe, Rubaii, Líppez-De Castro, and Capobianco (2017) argued that university community engagement and social responsibility programs had omitted some regions in Latin America due to language barriers leading to their marginalization. Nasir, Salamat, Ghani, and Redzuan (2017) discovered that many universities unintentionally exclude international undergraduate students in their UCE programs because this group is in the minority and had not been culturally integrated into their host universities. Similarly, the community of students who could benefit from the value-based proposition and scholarship of the universities is excluded from community-based programs in South Africa. Thus, the integration of the student community that resides on the university campus in U-CE forms part of the basis for this study.

Moreover, 23 out of the 26 official public universities in South Africa do not have approved CE policies, do not include CE in their institutional annual report and have no evidence of monitoring and evaluating CE projects in their institutions (Snyman, 2014). Table 2 gives an insight into this claim:

Table 2: An analysis of CE in South African universities
Adapted from (Snyman, 2014, pp. 48-60)

	Number of responses from the universities		
Questions	**Yes**	**No**	**Not Applicable**
Does the institution have an approved CE policy?	10	-	13
Is CE included in the institution's annual report?	9	14	-
Does the institution have a dedicated CE office?	15	8	-
Does the institution have an approved CE definition?	14	9	-
Is the definition of CE the same/similar to the one contained in the national policy?	14	9	-
Does the institution have an enabling environment for CE?	14	9	-
Are there any incentives for individuals establishing CE projects in the institution?	6	-	17

According to Table 2, most of the universities sampled by the researcher did not have explicit CE approved policies and failed to include the report of CE in their annual institutional report even though CE is one of the core functions of the university. Additionally, many of the universities sampled had offices set up for CE activities but motivations and resources to run these offices and staff morale were lacking. My study will endeavor to address how U-CE can be made to integrate and ensure more functionality in a university environment to address nutritional well-being issues and food insecurity.

2.2.6 UCE conceptual models

In this section, I will examine selected models of UCE, commonly applied in South Africa, to expatiate how UCE has been conceptualized in the literature. These models are not exclusive to the research that had been done but emerged from my searches of the literature. Firstly, three conceptual models that had been developed with regard to UCE focused mainly on the three roles of the university which are research, teaching and community engagement (Bender, 2008; Council on Higher Education, 2016b; Higher Education Quality Committee, 2007; Onwuemele, 2018; Preece, 2013). The authors suggested the following: Silo, Intersection and Infusion models of UCE which were also recommended by the Higher Education Quality Committee (2007). In conceptualising these models, "community" is viewed as being external to the university.

2.2.5.1 Silo model of CE

This model views the conventional functions of higher education institutions that are research, teaching and community engagement as separate entities that operate independently (Council on Higher Education, 2016b). The body argued that CE is considered an “add-on activity and not part of core academic project” (p. 243). Bender (2008, p. 87) described the community engagement in the Silo model as “service learning” that is traditionally construed as “community outreach and student/staff volunteerism”. The Silo model according to the researcher does not integrate CE with the other two roles of the university. Figure 1 is a diagrammatic representation of the Silo model of CE.

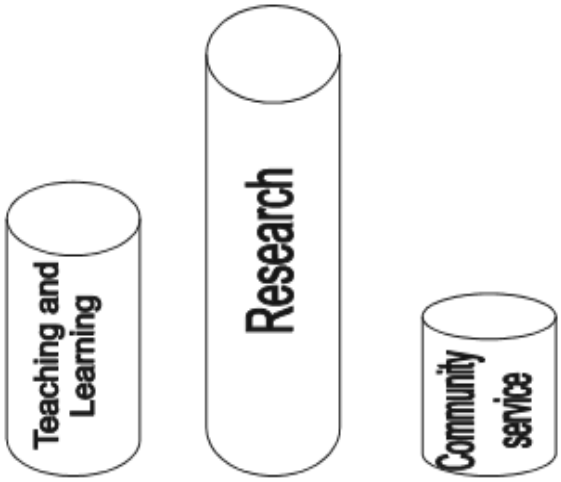


Figure 1: The Silo model of community engagement
(Bender, 2008, p. 87)

From Figure 1, the three silos symbolize the three roles of the universities, and reveal that they stand independently of one another. There is neither any intersection nor connection among the three functions. In addition, the size of each silo represents the level of priorities that has been accorded to each role by the university. The design of the silo model depicts that research takes the highest priority while community service receives the least attention (Wilson, 2013). In criticizing the traditional Silo model, the non-interaction between research and the community members makes it impossible to have empirical information about the concerns and pertinent issues of the members of the community (Fountain, Patel, & Buffin, 2007). The authors argued that the voices

of the community members are not heard and there must be involvement of the community in any university engagement to mitigate the disconnect.

2.2.5.2 Intersection model of CE

In the Intersection model, teaching and learning intersect with the community and service-learning while community-based outreach interconnects with research (Council on Higher Education, 2016c). These relationships depart from the view that community engagement or community service should be philanthropic (Council on Higher Education, 2016b). Figure 2 shows the model as the roles of the university interact with one another:

Figure 2: The Intersection model of community engagement
(Bender, 2008, p. 89)

From Figure 2, it is evident that the basic roles of the universities interrelate with one another while community outreach and volunteerism are still standing alone (Bender, 2009). The community outreach programs and volunteerism, according to the researcher are charitable activities, by members of the higher education institutions (HEIs), undertaken to assuage the needs of the community in focus without necessarily involving research inputs. The Intersection model focuses more on the problems of the community rather than emphasizing the promotion of civic social responsibility by staff and students of the university simultaneously (Bender, 2008; Gibbons, 2006; Onwuemele, 2018). The authors inferred that the one-sided benefit,

which centred, on economic gains for the community and excludes social transformation in the Intersection model, constitutes a setback for its implementation.

2.2.5.3 Infusion (cross-cutting) model of CE

The Infusion or Cross-Cutting model identifies two core functions: Teaching and learning, and research for the university and stresses that community engagement must “inform, animate and integrate with most of the teaching and learning and research activities” (Bender, 2008, p. 90; Higher Education Quality Committee, 2007). The incorporation of CE in research and teaching and learning should strengthen the quality and delivery of these two roles in the universities (Bender, 2008). Figure 3 shows the diagrammatic description of the Infusion model of CE.

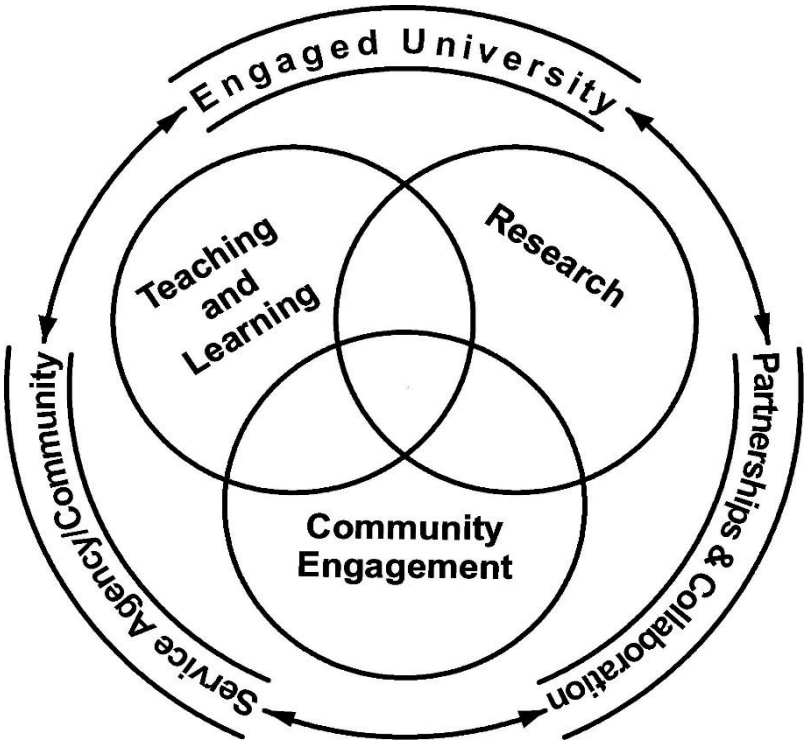


Figure 3: The Infusion (cross-cutting) model of community engagement
(Bender, 2008, p. 90)

The Infusion model in Figure 3 illustrates the participation, social agency and an engaged university interacting together. The Infusion model allows for mutual gains between the university and the community through teamwork, cooperation and tackling of societal exigencies affecting the communities (Wilson, 2013). For the purpose of my study, the Infusion model despite being integrative and encompassing the core roles of the university did not indicate a roadmap of how CE can be

implemented. Therefore, I submit that through this study, a model suggesting how U-CE can be implemented through using a critical pedagogical perspective would be recommended to support the efforts of the scholars before me. My model will be integrated into the Infusion model that identifies the teaching and learning, research functions and community engagement as core functions of a university. Sebeco (2019) contended that the Infusion model of CE makes the community members more involved in the CE projects in addition to the partnership that would have been established between the university and the community participating in the CE program.

More so, Mtawa et al. (2016, p. 126) contended that "the success of university community engagement in fostering social and economic development significantly relates to how much the practices of engagement is foregrounded in the universities' core policy and practice and how much academic scholarship draws on engagement activities". This view resonates with my study that advocates for a U-CE with a pedagogy that is aimed at bringing about conscientization among pre-service teachers in a university towards issues of health and nutrition and food insecurity. The PSTs and other students at universities do face challenges which are worthy of inquiry through U-CE.

2.3 Social challenges confronting the student community in the universities

Many challenges are encountered by students in universities around the world and bringing some of these issues into perspective will give more context to this study. In a study conducted at a Turkish university, Doygun and Gulec (2012) found that inadequate feeding, lack of accommodation, difficulty in adapting to campus life and anxiety about unemployment after graduation were some of the challenges facing students in that university. More so, unhealthy eating habits, nostalgia, poor financial management, insomnia, and clumsiness featured as part of the issues confronting students (Purdue University, 2019). Furthermore, financial problems, inadequate hostels, trouble acclimatizing to the university life, lack of regular electricity supply were discovered as some of the social predicaments challenging students in Nigeria, a West African country (Peretomode & Ugbomeh, 2013).

In Australian universities, stress had been identified as one of the social issues challenging university students, especially first-year undergraduates, and this

condition had been worsened by the poor food choices made by the students. Papier, Ahmed, Lee, and Wiseman (2015, p.324) discovered that there was “a clear difference in food selection patterns between stressed male and female students, with stress being a more significant predictor of unhealthy food selection among male students”. The authors’ findings indicated that first-year students, mostly males, experienced more anxiety due to their transition from high school to the university. This change could be overwhelming to the students regarding coping with living alone on the university campus without family members. Stress has been found to increase the intake of high-calorie food and high-fat snacks in people which can predispose individuals to diseases such as anxiety, depression, and anger (Liu et al., 2007; Zellner et al., 2006).

In the UK, non-infectious diseases is common among the university student community because the students consume unhealthy food and have reckless eating habits (Tanton, Dodd, Woodfield, & Mabhala, 2015). According to Deliens, Clarys, De Bourdeaudhuij, and Deforche (2014), university students that reside on-campus accommodation do not eat properly, and this behaviour could have negative impact on this health, well-being and academic performance.

In a study conducted in two universities in Victoria, Australia, students were found to be engaging in excessive drinking of alcohol (Supski, Lindsay, & Tanner, 2017). The authors discovered that students indulged in hazardous consumption of alcohol due to peer pressure, the quest to have fun and socialize with one another. Such behaviours exposed the students to dangers such as “disorientation, emotional upset, losing control and memory loss” which have health implications on students (Supski et al., 2017, p.233). In many developed nations, excessive drinking of alcohol had been revealed to be responsible for various health problems (Kypri, Paschall, Langley, Baxter, & Bourdeau, 2010). From the foregoing, relevant intervention programs that can mitigate these problems facing the ‘student community’ will directly or indirectly improve the well-being of the students. Hence the investigation of U-CE as one of the ways of assuaging such problems.

Within the setting of South Africa, poverty, hunger, food insecurity, mental health and lack of adequate accommodation are some of the challenges confronting university students (Speckman & Mandew, 2014; Swartz et al., 2017) In this study, food

insecurity is the challenge that has been selected because it resonates with the topic Nutrition in a biology module. Food insecurity and insufficiency have been linked to nutritional disorders (Laraia, 2013; Sorsdahl et al., 2011; Weigel, Armijos, Racines, & Cevallos, 2016). Maitra (2018, p. 7) concurred that “food insecurity is associated with overweight and obesity” in children and adults. Martinez, Frongillo, Leung, and Ritchie (2018) confirmed that food insecurity has negative effects on the mental health of students which can lead to poor academic performance.

Therefore, as a first step in exploring university student’s nutrient-poor diets, it is important to understand the importance of fruits and vegetables to healthy living. This would enhance the understanding of my study which focuses on cultivating fruit and vegetables to alleviate food insecurity and promote healthy living as part of the biology module.

2.3.1 Importance of food and vegetables to healthy living

Amao (2018) has advanced the importance of fruits and vegetables for better healthy living. The scholar argued that the pink/blue colour of fruits and vegetables represents the presence of antioxidants that lessen the danger of stroke, cancer and heart disease in human beings. Similarly, scientific proofs exist which confirm that the consumption of fruits and vegetables play a crucial role in the reduction of risk and prevention of chronic diseases such as coronary heart disease, cancer, and stroke (Bellavia, Larsson, Bottai, Wolk, & Orsini, 2013; Trichopoulou et al., 2003; Zhan, Liu, Cai, Xu, Xie, & He; 2017).

The following Table 3 highlights the importance of fruits and vegetables in the human diet because the food items can mitigate low-density lipoprotein (LDL) cholesterol which is harmful to the human body when it is in high concentration.

Table 3: **Dietary recommendations to lower low-density lipoprotein cholesterol and improve the overall lipoprotein profile (Klug et al., 2018, p. 995)**

	Preferred foods - eat regularly	**Use in moderation (1 - 3 times per week)**	**Best to avoid these foods (at most to be chosen occasionally in limited amounts)**
Vegetables and fruits (minimum 5 portions per day)	Raw and cooked vegetables Choose colourful vegetables Avocado, butternut, broccoli, cabbage, carrot, beetroot, green beans, peppers, pumpkin, spinach, and other green leafy vegetables and herbs, tomatoes, etc. Note: no added sugar and/or fat	Potato, sweet potato Note: no added sugar and/or fat	Vegetables prepared in oil, fat, butter or cream Deep-fried potatoes (‘slap chips’), potato crisps
	Fresh or frozen fruits (no added sugar)	Dried fruit, canned fruit (in natural juice)	Canned fruit (in sugar syrup), fruit juice, fruit prepared with added sugar e.g. fruit rolls

Table 3 lists several fruits and vegetables that should be consumed often, the amount of each and the guidelines for preparation. Gitt et al. (2016) claim that the reduction of LDL cholesterol by as little as 1 mmol/l (39 mg/dl) in the human blood has been proven by medical research to have a significant effect on easing the chances of coronary episodes and stroke for 5 years. MedlinePlus (2019 para. 2) compares LDL and HDL cholesterol as follows:

> LDL stands for low-density lipoproteins. It is sometimes called the "bad" cholesterol because a high LDL level leads to a build-up of cholesterol in your arteries. HDL stands for high-density lipoproteins. It is sometimes called the "good" cholesterol because it carries cholesterol from other parts of your body back to your liver. Your liver then removes the cholesterol from your body.

Consequently, heart diseases occur due to the blockage of the arteries by LDL cholesterol disrupting the flow of oxygen to the heart (MedlinePlus, 2019). This occurrence, to which the organization alluded, may lead to a stroke. Therefore, through the regular consumption of cabbage, spinach, carrot, beetroot, and other

vegetables, as indicated in Table 3, people's well-being and longevity can be enhanced. This information is relevant to the section on "Nutrition" and "Transport" (cardiovascular system) studied in the EDBS 310 module.

2.3.2 Food insecurity and hunger

Food security is described as a situation where healthy and uncontaminated food is accessible to people in an ethical way without the persons having to rummage, rob or rely on emergency nourishment provisions (Food and Agriculture Organization, 2004). In contrast, food insecurity occurs when there is difficulty in obtaining enough food or lack of access to adequate food which could be associated with poor purchasing power or insufficient means of acquiring food (Coleman-Jensen, Rabbitt, Gregory, & Singh, 2017; Food and Agriculture Organization, 2004). Welle (2011) argued that the condition where the seven billion people in the world are not hungry is possible despite natural catastrophes because adequate food is produced by the earth. She contended that the opinions of the famished people are not heard because their views are not genuinely pushed by multifaceted economic organizations and thus making hunger a political matter. The position of Welle (2011) can be compared to the experiences of food insecurity by students in universities, but their plight is not brought into the limelight due to political reasons and the underestimation of this problem by the authorities concerned. My research illuminates marginalized, food insecure students.

2.3.3 Food insecurity and hunger among students in universities of developed and developing countries

According to Patton-López, López-Cevallos, Cancel-Tirado, and Vazquez (2014), the lack of adequate nutrition among students in the State of Oregon, United States of America (USA) showed the prevalence of poverty affecting the student population. Similarly, the problem of hunger and food insecurity had made Northern Kentucky University (NKU) to set up "a campus community initiative called FUEL NKU, which is aimed at increasing awareness of hunger and getting food and toiletries to students in need" (Taylor, Canfield, & Larson, 2018, p. 29). In Canada, it was revealed that 35.3% of the students at the University of Manitoba were confronted with food insecurity which could negatively affect the students' healthy life and academic performance (Entz, Slater, & Desmarais, 2017). The other five major universities in Canada have

also been found to experience food insecurity, at an average of 39% of the students sampled, with two out of every five students affected with hunger (Silverthorn, 2016). The author bemoans the fact that the rising cost of food, housing, and tuition costs were the main causes of food insecurity while indigenous and government-funded students suffered the most.

Studies have shown that students in Australian universities also face monumental challenges related to food insecurity, because of their low socioeconomic background (Hughes et al., 2011). In addition, Lee et al. (2018) confirmed that food insecurity was prevalent among postsecondary students in Poland, Australia, Canada and the USA which are categorized as developed countries. The authors associated the challenge of food insufficiency and poor-quality diet among the affected students in these countries to lower their socioeconomic status which led to lowered educational achievement and well-being of the students.

Moreover, “the problems of under-nutrition, eating disorders and the double burden of over and under-nutrition in developing countries have not been explored to a great extent” among young adults of ages 18-25 years (Poobalan & Aucott, 2016, p. 10). The 2018 Global Food Security Index (GSFI) overall rankings table indicated a gloomy state of the situations in many developing countries regarding food insecurity. Among the 113 countries ranked, 37 countries that sat at the bottom of the table were Africa and other developing countries (The Economist Intelligence Unit, 2018). These countries were not food secure. Invariably, the students who attend universities in these countries will be vulnerable to food insecurity. Similarly, the level of hunger in seven developing countries had been categorized as alarming while another 43 countries suffered from a serious level of hunger based on the Global Hunger Index for 2016 (Von Grebmer et al., 2016). Additionally, Ukegbu, Nwofia, Ndudiri, Uwakwe, and Uwaegbute (2019) observed that literature was scarce regarding food security status among college and university students in developing and developed countries despite its relevance to good health and nutritional well-being. The authors revealed that food insecurity was prevalent in Nigerian universities among students whose parents were subsistence farmers and with students who had to work and study at the same time to fund their studies due to their low socioeconomic conditions.

The review of the literature suggests that material poverty among students at tertiary institutions locally and globally influenced their academic achievement negatively. In a case study conducted in Cape Peninsula University, Lourens and Bleazard (2016) found that first-year students from a less privileged background who did not receive financial aid in their first year of admission into the university performed poorly in their modules. The authors submitted that these students, who could not receive the bursary, may drop out of the university at the end of their second year. Similarly, Maringe and Sing (2014, p. 545) discovered that some students from poor financial settings who were described as "vulnerable dropped out of their studies to find work in order to support their families and save for tuition fees". The consideration of the socio-economic conditions and how these influence the quality and quantity of the universities' throughput and the well-being of graduating students is essential.

2.3.4 Food insecurity and hunger among students in universities in South Africa

It is pertinent to know that there is a high rate of poverty and unemployment in South Africa notwithstanding the advent of democracy in 1994 (Labadarios et al., 2011). The authors lament that poverty and unemployment had been worsened by the ever-increasing prices of food, petroleum products, and bank interest rates. In July 2019, the unemployment rate in South Africa grew from 27% to 29% from the first quarter to the second quarter of the same year in a population of 58 million people (Statistics South Africa, 2019). Unemployment results in food insecurity:

> Hunger is a condition in which people lack the required nutrients – both macro (energy and protein) and micro (vitamins and minerals) – for fully productive, active and healthy lives. Hunger can be short-term/acute or longer-term/chronic and has a range of mild to severe effects. It can result from the insufficient nutrient intake or from people's bodies failing to absorb the required nutrients – hidden hunger. Two billion people suffer from vitamin and mineral shortages. It can also result from poor food and childcare practices (World Food Programme, 2009).

Munro, Quayle, Simpson, and Barnsley (2013) argued that the lack of nutritionally adequate food to students at the University of KwaZulu-Natal (UKZN) is a barrier to academic outcomes, graduation, job prospects and socio-economic improvements of students. It is believed that families' economic and social position in relation to others, based on income, education, and occupation, affects the educational performance of their children in South Africa (Taylor & Yu, 2009). Internal UKZN reports have highlighted financial constraints that cause academic failure especially among students from poor backgrounds. These students find it difficult to fund study-related expenses such as accommodation, textbooks, and meals. A study of five other South African Higher Education Institutions (HEIs) reported similar causes underlying student failure (Wickham, Jones, Coetzee, & Bailey, 2008). “Students at South African institutions of higher learning who suffer food insecurity will additionally experience psychological and emotional stress as a factor that can impact negatively on health, self-esteem, and motivation, leading to academic underperformance and can prevent self-actualisation” (Sabi, Siwela, Kolanisi, & Naidoo, 2018, pp. 16-17).

There have been some efforts made by the government to alleviate poverty among the people after South Africa became a democratic nation, however, the country remains “one of the highest in the world in terms of income inequality” (Ramudzuli, 2019, p. v). The author associated the disparity in the income gap to socioeconomic factors such as access to health, literacy level, and the quality of the neighbourhood. A study conducted in South Africa by Kumo, Omilola, and Minsat (2015), revealed that people in 23% of the homes surveyed could not get enough food to eat while people in 13% of homes had experienced starvation in 2013. The authors conceded that food security remains a challenge in South Africa and that despite various government interventions to ease poverty, disparity persists among the people which affects societal integration. The university students from historically disadvantaged communities are not insulated from this problem. A common belief in South Africa is that obtaining a tertiary qualification will enable social mobility and poverty alleviation. Taylor and Yu (2009) asserted that being educated is seen as a route that makes individuals get job opportunities thereby overcoming the challenges of being raised in underprivileged settings in South Africa

The students from historically disadvantaged communities, who are predominantly Africans, form a major population of the total university student contingent in South Africa. The Department of Higher Education and Training (2013) confirmed that in the year 2013, 394 238 African students, out of a total number of 558 038, represents 68% of the total number of the student population that enrolled in the 23 South African contact universities. The Republic of South Africa (1998, p. 3) defined “historically disadvantaged persons as those persons or categories of persons, who prior to the new democratic dispensation marked by the adoption and coming into force of the Constitution of the Republic of South Africa Act, 1996 (Act No. 108 of 1996), were disadvantaged by unfair discrimination on the basis of their race and includes juristic persons or associations owned and controlled by such persons”. Many students residing in the university campus residence are historically disadvantaged and experience challenges such as hunger and lack of proper nutrition as a result of their poor economic background. This is based on both research studies which were reviewed and my personal experience and having lived in the campus residence for the last six consecutive years (from 2014 to 2019). In a study conducted at the Nelson Mandela Metropolitan University (NMMU), Gresse, Pietersen, and Steenkamp (2015, p. 94) stated that “Hostel students also reported a significantly lower consumption of fruit, vegetables, and dairy products, with 25 percent indicating insufficient funds as the reason”. The authors also argued that the monthly meal allowance, received by students on the National Student Financial Aid Scheme (NSFAS) funding, was inadequate to provide three balanced meals per day for a month. Hence, I suggest that there is a great need to pay more attention to the community of students who reside in the university accommodation having to struggle with food insecurity.

South African universities have privileged student accommodation at the expense of food security. Dominguez-Whitehead (2015) attested that in order to make housing more affordable to students, many South African universities do not provide food preparation in the university residence halls which makes the less privileged students' food insecure. Bruening, Argo, Payne-Sturges, and Laska (2017, p. 1767) concluded that “food insecurity was consistently associated with financial independence, poor health, and adverse academic outcomes”. My study explored university- community engagement (U-CE) linked to health matters related to nutrition and food security for

students thereby enhancing social consciousness and transformation through critical pedagogy.

2.3.5 Health problems and wellbeing related to nutrition affecting the university student community

The eating patterns of young people aged 16-21 years have been distorted in recent times as a result of a rise in the consumption of fast food, prepared by eateries, which are high in calories and fats (Berry, 2016). In a study carried out in Chilean state universities, Schnettler et al. (2015, p. 212) found that "a significant proportion of the student sample did not have a healthful diet and did not consume important nutrients as frequently as recommended, which negatively affects their nutrition, health, and well-being". The authors confirmed that the students with a poor healthy diet and welfare did not live with their parents during their university years. This result is significant to this study which explored how a U-CE project can make science socially relevant and responsive to the health and food security needs of students who reside in the university campus during their university years. Holt and Powell (2017) contended that the healthy living of student communities was within the university campuses warranted attention. A study at a United Kingdom (UK) university revealed that there is an urgent need for universities to place emphasis on projects that will enhance healthy eating decisions, learning how to cook healthy food and the importance of drinking water by the student community (Holt & Powell, 2017). The challenge of not having access to adequate and uncontaminated food can cause mental illness in human beings (Na et al., 2019). A combination of a balanced diet with an energetic lifestyle will ensure good well-being of humans and the prevention of diseases such as obesity, cardiac problems, and cancer (Price, 2005).

IFRC (2013, p. 31) illustrated the composition of a varied and balanced diet as follows:

> A varied and balanced diet means including different types of foods such as:
>
> a. Staple foods (millet, barley, sorghum, maize, rice) with every meal.
> b. Pulses, green leafy vegetables and red/yellow/orange fruits and vegetables every day.
> c. Fish, meat and dairy products whenever possible.

d. Small amounts of fats such as butter, oil and/or oily seeds daily with meals.

Unfortunately, food-insecure students in the universities will not be able to acquire a balanced diet routine and thus are being predisposed to some of the health problems highlighted in this section.

According to IFRC (2013), Table 4 shows the details of the four basic food groups required for healthy living while Figure 4 displays a diagram showing how different food from the food groups should be combined to have a balanced diet. The reason for including this information is that it is part of the topic “Nutrition” which is taught in the BIO 310 module. It also relates to my study which points to several indication of food insecurity, including an unbalanced diet.

Table 4: The four basic food groups
(IFRC, 2013, p. 20)

Four basic food groups* (for a healthy diet choose every day from each group)	
Staple foods (starches) – energy • Grains and cereals – wheat, sorghum, rice, millet, maize/corn, teff, etc. • Products made from grains – bread, noodles, tortillas, chapattis, pasta, polenta, couscous, rice cakes, etc. • Tubers and roots – cassava/manioc, potatoes, lotus, yams, taro, etc.	**Vegetables and fruits – micronutrients** • Vegetables – green leafy and orange vegetables: spinach, cabbage, lettuce, fresh green herbs, chard, amaranthus, carrots, pumpkin, tomatoes, red peppers, etc. – other vegetables: okra, cauliflower, broccoli, onion, radish, mushrooms, eggplant (aubergine), etc. • Fruits – orange fruits: papayas, mangos, pomegranates, etc. – other: dates, citrus fruits, avocados, melons, apples, guavas, berries, plums, etc.
Meat/animal products and legumes/nuts – proteins, micronutrients • Pulses, green beans and peas: chickpeas/cowpeas, kidney beans, soy beans, lentils, green peas, etc. • Products from beans: – tofu/soy curd, bean sprouts • Nuts and seeds: – groundnuts, almonds, cashews, sesame, etc. • Fish and shellfish • Meat, insects and game • Poultry • Eggs • Dairy: – milk, yoghurt, curds and cheeses, dried milk powder	**Fats – energy, vitamin A** • Butter, ghee and margarine • Vegetable oil (fortified with vitamin A) • Oily seeds: – sunflower seeds

Figure 4: Food from the four basic food groups should be eaten each day
IFRC (2013, p. 31)

Table 4 gives a breakdown of the food groups that have the essential nutrients for humans' healthy living. The food groups comprise carbohydrates, proteins, fats, vegetables, and fruits. These components have both macro and micronutrients. Each

group functions as follows: 1. Carbohydrates provide energy to the body, 2. Proteins enable body growth, 3. Fats stores as energy in the body, 4. Vegetables and fruits provide vitamins for fighting germs and diseases with minerals for strong bones and teeth (IFRC, 2013). In Figure 4, the four groups of food are divided into parts of the pie diagram. The size of each part represents the amount or ratio of servings that people should eat in a balanced diet. From Figure 4, vegetables and fruits take about a quarter of the diet which shows their significance. A lack of insufficient vegetable and fruit intake in a diet can expose students to ill-health conditions.

Furthermore, the increasing risk of cardiovascular diseases among students of higher institutions of learning has been attributed to an unhealthy diet and lifestyle (Almas, Hameed, & Sultan, 2008; Arts, Fernandez, & Lofgren, 2014; Aziz & Gomaa, 2017; Risk & Bilgi, 2014).

In a study conducted among university students in 22 countries, including South Africa, Peltzer et al. (2014) confirmed that obesity was prominent. The researchers discovered that university students in these countries did not possess the requisite knowledge of proper nutrition that could combat being overweight. The result of Peltzer et al. (2014) was corroborated by the World Health Organisation (2019 para. 1) that explained that the “Global Strategy on Diet” must include the curtailing of unhealthy food by human beings to stem the rate of death and illnesses. Given the preceding views from the literature, I suggest that a U-CE project aimed at reducing the risk of exposing university students to diseases such as cardiovascular events, hypertension, and stress is crucial in this age of fast food popularity.

2.4 The need for a pedagogy that responds to the needs of pre-service teacher well-being

Pre-service teachers have been identified as catalysts of social transformation which informs that the pedagogy and curriculum used for preparing these trainee teachers for professional lives must be invigorating and socially relevant (Avidov-Ungar & Shamir-Inbal, 2017; Kasun & Saavedra, 2016; Shizha, 2007).

Lotz-Sisitka, Wals, Kronlid, and McGarry (2015, p. 73) have underscored the necessity for higher education science pedagogy to be “transgressive rather than relying on resilience and adaptive capacity building” which did not produce the much-needed

social change but rather improved societal problems marginally or maintained the status quo. The authors maintained that science pedagogy, when implemented in the HEIs, must be able to provide solutions to complex problems facing society, incorporating scientific with social viewpoints, be multi-disciplinary, problem-solving based and for the transformation of the society. “Teaching and learning pedagogies are essential in teacher education, as teachers are agents of curriculum implementation and change in every society” (Major & Thalia, 2018, p. 8). In a study conducted in Botswana, Major and Thalia (2018) found that pre-service teachers rejected the traditional lecture method of teaching which placed the lecturer at the centre of the pedagogical process because the trainee teachers were passive rather participatory learners. Additionally, Perumal (2016) criticised the South African curriculum for training teachers as flawed with content that could not prepare teachers to be democratic, transformative intellectuals and responsive individuals who could confront social challenges using their professional capabilities. The authors recommended a curriculum based on critical pedagogy rather that the current one with technical details associated with the historical past and other issues of the country but not innovative enough to provide solutions to the contemporary issues affecting the country.

Subsequently, this study proposes a type of critical pedagogy in which pre-service science teachers (PSSTs) would engage with the non-biology pre-service teacher (NBPST) community on a university campus.

It is believed that the PSSTs would serve as a catalyst for social transformation by using their content knowledge on nutrition to investigate nutritional and health challenges facing NBPSTs who reside on campus. In addition, it is assumed that PSSTs will appreciate and include indigenous plants in the U-CE food garden project that will address the challenges faced by NBPSTs by cultivating crops that can manage various health and nutritional conditions identified. More so, it is hoped that during the U-CE engagement, the PSSTs would have enabled NBPSTs to become more skilled in food gardening and consequently more self-sufficient.

This study motivates for a critical pedagogical approach to science education. How one teaches influences one’s professional self. It is necessary to explore pre-service teacher professional identity.

2.4.1 Pre-service teacher professional identity

Professional teacher identity development is a dilemma for pre-service teachers who must navigate among a myriad of matters such as their personal perceptions of teachers, based on their experience of teaching practice, learning to teach processes offered by the teacher education curriculum and what the society expects from them (Beltman, Glass, Dinham, Chalk, & Nguyen, 2015; Olsen, 2008). In the teacher development process, from pre-service to service teaching, the matter of teacher identity is significant (Alsup, 2006; Danielewicz, 2014; Friesen & Besley, 2013). Teacher identity is a complicated mix that has a host of components (Olsen, 2008). The following Figure 5, according to Olsen (2008, p. 25), illustrates the complexities that shape the identity of a teacher in professional life.

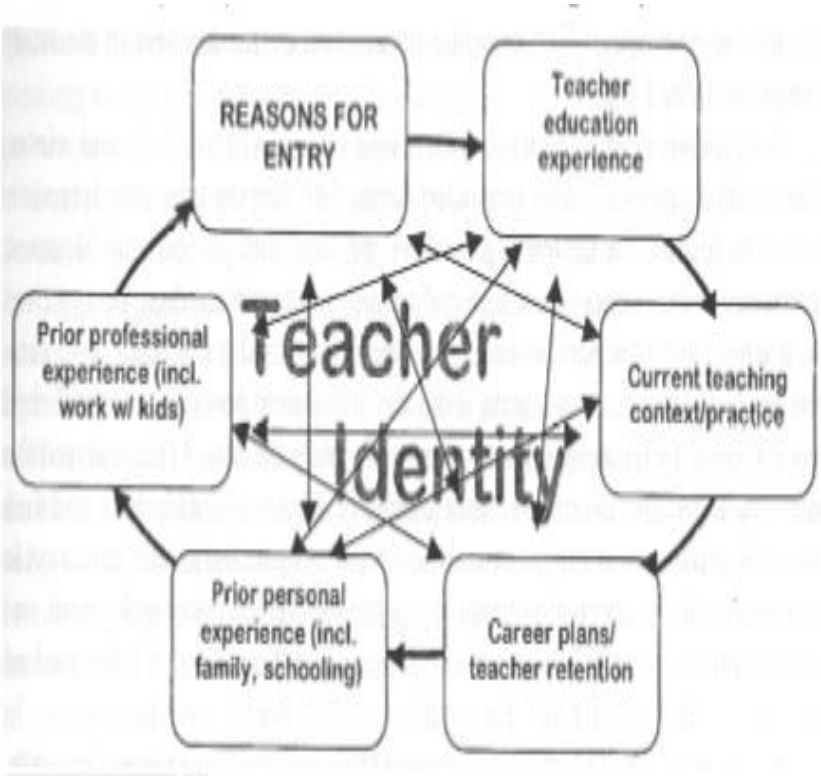


Figure 5: Teacher Identity as Dynamic, Holistic Interaction among Multiple Parts
(Olsen, 2008, p. 25)

The various components highlighted in Figure 5, demonstrate the interwoven nature of the factors that connect in no order, to shape the identity of a teacher. Thoughts and events such as an individual's background, social settings, previous experiences, ambition (as this relates to Figure 5), lead to the development of teacher identity.

To further substantiate the complexities of teacher identity, Izadinia (2013) suggested the following model in Figure 6 of how pre-service teachers mature to attain a self-image for the teaching profession.

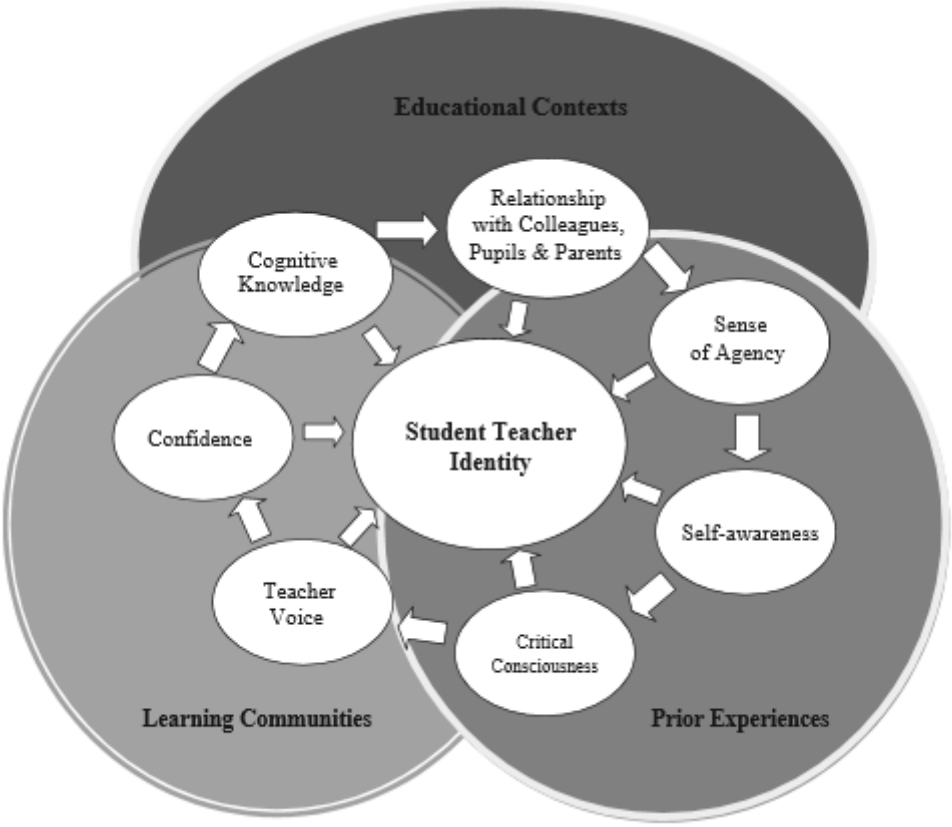


Figure 6: Student teacher's identity
(Izadinia, 2013, p. 708)

According to Izadinia (2013), whose model is presented in Figure 6, many factors can build teacher identity in pre-service teachers. The broad features such as "educational contexts, learning communities and prior experiences" (p. 708), encompass other necessary sub-elements in the intersecting circles. It should be noted that some components of developing teacher identity are significant in my study that investigated the impact of U-CE on the identity and future practice of pre-service science teachers in the school of education in a university.

Despite research on teacher identity as being related to the social circumstances surrounding pre-service teachers' development, aspects such as the contemporary issues confronting teachers and the power of teacher identity in the classroom setting have not been given adequate consideration by scholars (Reeves, 2018). In another

view, Olsen (2011) argued that a theoretical framework is critical in supporting the complexities associated with the build-up of teacher identity. Izadinia (2013) analysed 29 evidence-based studies on teacher identity and discovered that four main emphases emerged in the work of these researchers. These findings were "(1) reflective activities, (2) learning communities, (3) context and (4) (prior) experiences" (Izadinia, 2013, p. 694). However, only three out of the 29 first-hand studies highlighted the negative shortcomings in teacher identity development that, in her view, relate to pressure experienced by the pre-service teachers. This pressure, Izadinia (2013, p. 703) asserted, concerns the blending of the "constructivist nature" of teaching and other methods that pre-service teachers were trained with while in the higher institution of learning with "traditional" teaching in the schools that the practicing teachers want them to emulate. My study disrupted this pattern by adopting a critical approach to learning to teach. This was to integrate critical pedagogy into their professional growth towards becoming teachers which could be adapted to the school context in which they find themselves in the future.

Bennett (2013, p. 53) contended that "identity development is a continuous process framed within changing social and historical contexts". The author insists that self-identity must take a series of steps to attain it. In a study conducted in South Africa, Oswald and Perold (2015) discovered that a teacher's identity emerges from the social experiences of the teacher that have been reflected upon over time and these pieces of knowledge shape the outcome of his/her professional self-image. The researchers affirm that in the process of transforming to develop self-identity in a teaching career, a teacher develops agency for change within the context of the social system in which he/she finds him/herself. To corroborate the result of Oswald and Perold (2015), Steenekamp, van der Merwe, and Mehmedova (2018) found that pre-service teachers' exposure to educational activities, such as an excursion influences their constructive development of teacher professional identity towards compassion that inspires them to be agents for change in the classroom. As part of the U-CE project undertaken by the participants of this study, the pre-service science teacher participants went on an excursion to an Eco-school. There they were taught about eco-friendly and indigenous ways of planting food garden plants to address nutritional and health needs as well as food insecurity among the student community that resided in that university campus.

In addition, Sutherland, Howard, and Markauskaite (2010) observed that in the process of becoming a teacher, pre-service teachers reflect through their practices in the teacher training course and in effect incorporate their experiences to conceptualize self-esteem for professional identity. Teacher identity can bring about a professional agency that can be used to improve societal dialogues and the bargaining of transformational changes in the schools and the country at large (Buchanan, 2015). Therefore, I argue that through the U-CE, pre-service science teachers will integrate the constructs of change and transformation into their learning to teach thereby enhancing future pedagogical principles when they become professional teachers.

In designing the biology module, where food security was a central concept with the teaching of nutrition, and a critical pedagogical stance was advanced, the cultivation of indigenous plants was encouraged. This marked another digestion from the "normal" curriculum because PSTs were encouraged to cultivate African indigenous plants, based on the knowledge they constructed from an IK holder. Therefore, it is necessary to include literature on IK and its relatedness to the curriculum.

2.4.2 Indigenous knowledge infusion in university curriculum vis-a-vis decolonization of the curriculum

UNESCO (2017 para. 1) defined local and indigenous knowledge to be "the understandings, skills, and philosophies developed by societies with long histories of interaction with their natural surroundings. For rural and indigenous peoples, local knowledge informs decision-making about fundamental aspects of day-to-day life". Govender (2012, p. 112) expressed Indigenous Knowledge (IK) as "a body of valuable knowledge produced and owned by local people in their specific communities and found worldwide". Maurial (1999, pp. 62-63) described IK as "people's cognitive and wise legacy as a result of their interaction with nature in a common territory, IK is local, holistic and agrapha". The author explains that IK is the knowledge that is localized to a place, it forms a body of worldview when compared to other neighbourhoods and it is passed from one generation to another verbally. It should be noted that efforts to make IKS part of the science syllabus is not exclusive to South Africa because countries such as the USA, Canada, Australia, the Middle East, South America, and other African countries have endeavoured to do so (Vithal, Adler, & Keitel, 2005).

Domfeh (2007) submitted that it will be a natural injustice if the indigenous knowledge of communities that deals with plants, animal lives, territories and interactions with the environment are not studied, harnessed or put into commercial usage. “IKS reflects the wisdom about the environment developed over the centuries by the inhabitants of South Africa, and much of this valuable wisdom believed to have been lost in the past 300 years of colonization now needs to be rediscovered and utilized to improve the quality of life of all South Africans” (Ogunniyi, 2007, pp. 963-964). The need to integrate IKS and the science curriculum to come to a consensus has been contended by Diwu, Ogunniyi and Langenhoven (2011). Efforts and discourse have been ongoing to include IK in the curriculum in South Africa (de Beer & Petersen, 2016; Hewson & Ogunniyi, 2011; Nordling, 2018; Ogunniyi, 2007). However, Naidoo and Vithal (2014) argued that the best approach to making IKS most useful is to integrate it into the national curricula of South Africa.

Moreover, the Department of Basic Education (2011, p. 17), infused IKS in the biology subject curriculum by stating that “Learners must be exposed to the history of science and indigenous knowledge systems from other times and other cultures. Scientific knowledge and understanding have been developed over time by people who were curious and who persevered with their quest for knowledge”. Mudaly (2018) found that with the inclusion of IK in pre-service science teachers’ training program, a change in the exclusively Eurocentric-epistemological approach to the appreciation of African epistemology was prompted which enhanced pre-service teachers’ professional identity. She contends that integrating IK in the university curriculum is a form of decolonizing the curriculum which can impact the pre-service teachers’ worldviews.

Seehawer (2018) observed that despite South Africa and other Southern African countries recognizing the values of IK, in-service teachers in these countries are yet to have a good grasp of how to incorporate IK in the science classroom. With this view from Seehawer (2018), I reason that my study, that infused IK ways of planting and maintaining food gardens, would broaden pre-service science teachers’ perspectives and ease the confusion of teaching IK with conventional science when they begin to practice as future teachers. “Indigenous knowledges are about survival, identity, and flourishing of the people holding these knowledges, the practical nature of IK calling for a hands-on learning-by-doing approach” (Seehawer, 2018, p. 107). Furthermore,

Koopman (2018) suggested that learners doing science subjects must be given the chance to engage with their previous experience and traditional knowledge as this advances the decolonising of the science syllabus. My study is significant in the context of the assertion made by Koopman (2018) because pre-service science teachers who participated in my study became aware of the values of IK in science.

In a study undertaken in Cape Town, South Africa, Jacobs (2015) recommended that a pre-service science teacher's curriculum should be infused with IK. He maintained that the experience gained while learning to teach science will equip the trainee teacher to apply IK and cultural circumstances of the learners to effectively teach science. In research at a university in KwaZulu-Natal, South Africa, Naidoo (2010) asserted that pre-service teachers must be exposed to African and IK to prepare them for the science classroom where they will integrate IK with Western science. Naidoo (2010, p. 217) added that "what a teacher knows will influence what he or she does in the classroom so one way to improve teacher effectiveness must surely be to ensure that teachers have the IK knowledge" as pre-service teachers, or re-trained if already in-service teachers but lack IK. Govender (2014) also noted that the IKS discourse is useful because it allows students to think critically about IKS- science issues. Therefore, by including the indigenous ways of planting food garden vegetables and crops in this study, pre-service science teachers experienced the first-hand process of integrating IK with 'Nutrition' topic in biology which ultimately raised the conscience of the participants to how teaching for transformation could be done in the classroom as future teachers.

2.5 Gaps in the literature

Literature is replete with studies about UCE where universities serve nearby or regional communities as part of service-learning or other programs. However, studies related to universities serving their own students through U-CE appear to be scarce. Research into food availability, affordability, and consumption by university students in the South African context is sparse. Dominguez-Whitehead (2015, p. 293) submitted that the problems faced by South African university students in order to "acquire and consume food on a regular basis" is not getting enough attention. The challenges of students in the tertiary institutions in South Africa in terms of food uncertainty is not well documented (Munro et al., 2013). In my study, I will address this paucity.

In the literature, the research on U-CE and model for its implementation is also scarce. The policies of different university community engagement that were explored in the literature lack U-CE, but all had UCE. The engagements of these universities were based solely on partnerships with neighboring and regional communities. UCE comprises service-learning, outreach, volunteering, partnering with local, regional communities and organizations to alleviate social ills or engage for mutual benefits (Bourke, 2015; Jacob, Sutin, Weidman, & Yeager, 2015; University of the Western Cape, 2017; University of Zululand, 2018). The application of critical theory and critical pedagogy is not common in South African literature as it concerns preservice science students. CP has been theorized in Brazil, South and North America and Europe. Literature is scarce about its epistemology about the South African context with pre-service teachers.

2.6 Theoretical framework guiding this study

2.6.1 Critical theory

Rasmussen (1996) explained that critical theory has the propensity to create transformation in the social order because it gives purpose needed in a historical group which ultimately changes the world. The author argued that critical theory has its foundation from the ideology which construes that opinion can change on its own through self-meditation in a historic period. “Critical theory strives to reduce the suffering of the people and promotes happiness” (McCarthy, 1994, p. 17). Human beings possess the nature of bliss which should imply that an environment with such a feeling must be created for peaceful coexistence (Fuchs, 2016). Additionally, Marcuse (1989) held that there is a positive relationship between humankind’s contentment and its standard of living which actualizes through transmutation. He added that for a society to achieve a noetic state, the economic and political dynamics must be assessed, in a historical context, as this will crusade the revolution agenda of that culture. These claims were supported by Kellner (2019) who asserted that a vision of utopian society was relevant in this contemporary period where the people envisage an emancipating and happy society.

Weber (1977) contended that critical theory should not be located only in Marxism and its distinctions but should be conjectured as a theory that is reached as the truth through rational opinions and has emancipation as its message and objective. The

community of students, who participated in this research, came from a predominantly poor background possessing the historical lineage with the Apartheid past of South Africa.

The value of critical theory is its ability to upset and contest the existing state of affairs (Asghar, 2013; Erginel, 2006; Weston, 2015). The scholars concurred that the status quo where events bring about oppression, bondage, power relations and unpleasant situations, the paradigm of critical theory inclines to challenge that condition. Tonelli (1971, p. 1) alluded to the fact that the "Age of Enlightenment", epitomized by the historians of philosophy, was the period when the sagacity of human beings changed from the era of obeying restraining traditional rules and institutions to the path of unlimited improvements. Critical theory, while relying on the enlightenment practice, regards social science to be instrumental in the liberation from "unnecessary restrictive traditions, ideologies, assumptions, power relations, identity formations, and so forth, that inhibit or distort opportunities for autonomy, clarification of genuine needs and wants and therefore greater and lasting satisfaction" (Alvesson & Willmott, 1992, p. 435). Bertram and Christiansen (2013) asserted that the emphasis of the critical paradigm is the transformation of society. These authors stressed that people who have been disadvantaged or are less privileged are expected to benefit from the change. Thus, I viewed critical theory as a theoretical framework necessary in the context of South Africa, a country that is still undergoing the process of transformation after gaining freedom from the Apartheid regime. Critical theoretical constructs also paved the way to challenge participants of this study to become more conscious and civic minded.

Asghar (2013) maintained that the critical viewpoint as a research paradigm can provide intuition not only by scrutinizing and investigating situations but also bring about a plan of transformation. The author further explained that researchers usually prefer the positivist and constructive paradigms as lenses to acquire credible information in a visible form without exploring the critical theory, which is comparatively newer, and possibly more potent than the positivist and constructivist paradigms.

2.6.2 Critical pedagogy

Fortney (2011, p. 1) defined critical pedagogy as an "educational theory in which teaching and learning tools are used to make learners aware of the autocracy of social

conditions". Giroux (2011) disagreed with the conventional supposition which describes pedagogy as an array of approaches and dexterity for instructing stated contents in the curriculum. He argued that critical pedagogy stretches beyond using prescribed teaching methods which does not take cognizance of the backgrounds, but critical pedagogy relates to the precise situation, students, groups and wherewithal at the disposal of the people concerned. Kincheloe and McLaren (2002) maintained that Henry Giroux and other scholars disagreed with the Samuel Bowles and Herbert Gintis, who theorized that schools were capitalist means of replicating socio-economic and cultural bureaucrats. The authors added that Henry Giroux and other intellectuals argued, rather, that schools should be settings of expectation and democratic sites of resistance where educators and learners are free to learn using a variety of teaching methods. According to Burbules and Berk (1999), critical pedagogy is conceptualized to assist educational organizations to make students query issues such as inequality of power, self-defeatist attitude about their future ambition, due to some personalized ideas, to change these false beliefs in their lives. I argue that through the boldness to challenge self-defeating circumstances, students are empowered to become agents of change and transformation.

Gruenewald (2003) asserted that Freire, Giroux, and McLaren are the proponents of critical pedagogy who agreed that both teachers and students must be academics of change because teaching and learning constantly have political undertones. Fernandez-Docallas (2016, p. 27) affirmed that:

> A critical pedagogical practice does not transfer knowledge but creates possibilities for its production, analysis, and use. Without succumbing to a rigid dogmatism, teachers must provide the conditions for students to bear witness to history, their own actions and the mechanisms that drive the larger social order so that they can imagine the inseparable connection between the human condition and the ethical basis of our existence.

Using Antonio Gramsci's ideology that pointed to critical thinking and modern pedagogy, Balampekou and Floriotis (2012) conceded that contemporary methods of instruction should regard the learners as teachers, as educational partners in the curriculum development and contributors in the societal development outside the walls of the school. The authors alluded to the fact that the social order would be positively

impacted which culminates in the objectives of critical science education. Gramsci (1970) argued that for the social structure to be maintained by the potentates, the brainwashing of the school learners was pertinent which can be achieved through the form of education being provided at schools. He contended that the pact between the leaders of the society and the governed does not depend only on compulsion but also on unscrupulous influence and accord to maintain their supremacy. According to Antonio Gramsci's work from his prison notebook, as translated from Italian to English language by Hoare and Nowell-Smith (2005), imagination should be the crux of education. Hoare and Nowell-Smith (2005), argued that the place of learning does not mean a place of innovators but rather a centre where self-generation and self-directed education of learners take place, without prearranged course, and under the watch of affable educators who channel the process from early childhood to university. Consequently, my study provided a platform for the PST participants to exercise creative, self-generating and self-directing will that raised their consciousness about health and nutritional matters affecting the student community. It also paved the way for the enhancement of teacher identity as professional practicing teachers.

Freire (1970) disputed the concept of the "narrative character" of teaching in which teachers give all the information and students only accept, learn by rote and recite. The scholar terms this notion "banking concept of education" which is deficient in "creativity, transformation and knowledge" (p. 72) thereby making people less human. The running of the education system for commercial purposes has made government schools and institutions of higher learning victims of this scheme which weakens the analytical scholarship diminishing fledgling students as advocates for an egalitarian and fair future (Giroux, 2008). Similarly, Nikolakaki (2012) bemoaned the type of education being promoted by the neoliberals between 1932 and 2012, which deprives students of crucial inquiry skills required for connecting to the real world, private or political and cutting off their cognitive and intellectual abilities. Giroux (2011) agreed that the objective analysis of information is a civic duty and enables an individual or in conjunction with other persons to get involved in realism, break away from their past and the past created for them by the community.

Furthermore, critical pedagogy is an instructional method that seeks to embellish the conscientization of students for them to interrogate and confront repressive circumstances and the opinions that oppress them (Morris, 2015). The author

contended that the theory explores the connection between instruction and acquiring knowledge which can be “a continuous process of unlearning, learning and relearning, reflection, evaluation and the impact that these actions have on students, in particular students who have been historically disenfranchised by traditional schooling” (Morris, 2015, p.160). Thus self-respect and liberty of students will be deprived if the pedagogy used by teachers is designed to make them compliant and submissive (Covaleskie, 2003).

Some scholars have criticized the use of the concept of critical pedagogy in the classroom. Thomson-Bunn (2014, p.1) argued that much of the dialogue on critical pedagogy centres on the “abstract ideas such as social justice, student empowerment, co-construction of knowledge, and critical thinking” that were not understood by the students in the classroom. More so, Clemitshaw (2013) contended that CP places a huge demand on both teachers and students to contest the powers that exist in an oppressive system to achieve emancipation. Teachers have to resist neo-liberal influences that aim to commodify education, turning them from public good to private good, while at the same time students struggle to discover their authentic voices.

Despite these shortcomings, Fobes and Kaufman (2008, p. 26-27) summed up the strengths of critical pedagogy as follow:

- Encourages the eradication of the teacher-student contradiction whereby the teacher teaches, and the students are taught; the teacher knows everything, and the students know nothing; the teacher talks, and the students listen; and the teacher is the subject and the students are mere objects.
- Promotes a problem-posing dialogue (instead of a banking/lecturing style) that emanates from the lived experiences (generative themes) of the learners.
- Fosters epistemological curiosity in both teachers and learners.
- Strives for praxis: reflection and action of the social world in order to transform it.

Given the foregoing, it is hoped that the application of critical pedagogy, in this study, will stimulate reflection, epistemological inquisitiveness, and enthusiasm in the participants for transformation and social action in the field of science education.

2.6.3 The link between the theoretical construct and this study

According to Mahmoudi, Khoshnood, and Babaei (2014, p. 86), “the purpose of critical pedagogy is to enrich students’ overall life. In such an approach, students are given the chance to challenge others’ accepted hypotheses and to explore the relationship between their society and the content of their educational environment”. The adoption of critical pedagogy in this study is pertinent because it provides an opportunity for the PSSTs to have a voice regarding the way they are being taught at the university. The encouragement of IK and relative independence was given to the PSSTs to carry out research that enabled the participants to experience biology about their educational environment and how it can assist in preventing malnutrition, managing health challenges and in reducing hunger among students who reside in the university residences. Many students in the South African universities are products of the communities to which the university provides the conventional community engagement programs, that is, communities that are usually selected on account of their low socio-economic status. Thus, the student community serves as a group that is comparable to local communities that the universities serve to fulfil one of their core objectives.

In addition, the introduction of critical pedagogy in the curriculum for the training of pre-service teachers is pertinent to the transformation of the society (Barnum & Illari, 2016; Cappy, 2016; Ferrigno, Hemphill, & Lee, 2005; Keesing-Styles, 2003). Therefore, by using critical pedagogy from the work of Henry Giroux and other pedagogues to view this study, I intended to conscientize the PSSTs to becoming agents of change in the society rather than being complacent professional teachers in their future practice. Critical pedagogy, in my study, enabled the PSSTs to experience a pedagogy that developed consciousness and civic responsiveness to the issues of health and nutrition and simultaneously carved a different teacher identity.

2.7 Conclusion

Literature has indicated that different meanings for the word ‘community’ abound and scholars have not been able to agree on a specific definition of the term. However, many of the researchers indicate that a community comprises people interacting with one another, living in a geographical area and guided by some norms. More so, a community can be a locality or a region around the university. Additionally, literature

recognizes that community can be students and or staff members of a university. Thus, this assertion resonates with my study that focused on the student participants, who are pre-service teachers in a university in KwaZulu-Natal, that forms the community of students under study.

Moreover, the literature which was surveyed provided insights into how universities and other HEIs have defined and implemented UCE in their various institutions. It should be noted that most HEIs regard UCE as the engagement with communities in the locality and regions of the universities where they collaborate, partner and provide services to meet the economic needs of the communities. On the contrary, other scholars have argued that the partnership should go beyond providing services that meet the basic needs but to involve research, which will transcend the notion or role of charity to transform the communities, and other scholastic engagements that will be of benefit to the HEIs. This call, according to the literature, is being adhered to and different forms of engagement, including SL, which is credit-bearing in some cases, have been introduced and strengthened.

Also, it was expressed in the literature that UCE with local, regional and national communities can induce social change and transformation and more especially in the South African context. South Africa is still reeling from its historical past of apartheid and many communities that were previously disadvantaged, require transformation and socioeconomic upliftment. Thus, UCE can assuage some of the social ills through partnership, collaborations, and research which can also enhance students' professional development while studying through the various universities. The Council on Higher Education (2013, p. v) in its 'Kagisano' 9 issues emphasized that one of the aims of higher education in South Africa is to "contribute to the socialization of enlightened, responsible and constructively critical citizens"

In addition, criticisms of how UCE has been implemented have been alluded to by some of the authors. The literature bemoans how some universities haphazardly implement UCE without adequate conceptualisation of the program. It was discovered that some staff members carry out UCE based on personal efforts which could essentially be referred to as volunteerism. Further, researchers decry the lack of quality assurance by institutions to measure the success or failure of the UCE programs that the institutions embark upon.

There are three main conceptual models of UCE that were worthy of explication, based on my study. These were selected based on the increasing inter-relatedness that they revealed among the three core functions of the university. They are the Silo, Intersection and Infusion models. Authors have stated that according to the Silo model, the three fundamental roles (teaching and learning, research and community engagement) were not significantly integrated. All three roles in the Silo model are independent of each other. The Intersection model did intertwine the three key roles of the university but provided room for volunteerism and outreach as part of its community engagement. Lastly, the Infusion model argues that teaching and learning and research must integrate into the implementation of CE in the institutions. Conversely, in as much as these models have been well interrogated in the literature, models for step-by-step implementation of CE using one or different philosophical frameworks are scarce. I intend to expand on the Infusion model by proposing a detailed implementable model of U-CE.

In addition, the literature review revealed the challenge of food insecurity and hunger being experienced in universities in local and international settings. Food insecurity is experienced by university students in the USA, Canada, the UK and Australia all of which can be regarded as developed countries. Many developing countries are affected by food insecurity with most of these nations found in the continent of Africa based on the literature findings. Poor socioeconomic factors, poverty, and unhealthy lifestyles were some of the reasons responsible for food insecurity among the developing countries. Scholars have also alluded to the prevalence of food insecurity among university students in South Africa which is where this study is conducted.

Issues of health such as cardiovascular diseases, obesity, and mental disorder had been identified to be caused by the lack of a healthy and balanced diet. According to the literature, the lack of a good diet rich in the micro and macronutrients could have detrimental effects on students' health and their academic performance.

More so, scholars have argued for a more radical and transgressive teacher education curriculum rather than the curriculum that is technical and does not offer a transdisciplinary approach. The literature argued for a teacher curriculum that will do things differently rather than doing things better. Scholars advocated for a teacher education curriculum that will integrate scientific and contemporary societal views to

proffer solutions to myriads of challenges in the society. Thus, through a critical pedagogy for teacher education, scholars believed that pre-service teachers' professional identity would be influenced for their future professional practice. It was argued in the literature that a radical, transgressive and critical teachers' education curriculum can encourage pre-service teachers to become change agents when teaching in their schools and society. Consequently, I predict that, through this study, emphasis on the development of teacher identity and IK inclusion in the pedagogy of PSSTs can make the teacher training program more radical.

Finally, the literature review and the theoretical framework gave impetus to the research design, presentation of data, analysis, findings, and recommendations that emerged from this study. The following chapter will discuss the research design and methodology that was chosen for this research.

CHAPTER 3: RESEARCH METHODOLOGY

3.1 Introduction

This chapter describes the research methodology employed in this study. McMillan and Schumacher (2014, p. 6) defined research methods as “the procedure used to collect data and analyse data”. Thus, the details of how the data for this study was generated and analysed are presented in this chapter. Firstly, the context and setting under which the study was carried out are explained together with the circumstances that informed the research. Secondly, the justifications for selecting the critical paradigm, and the qualitative approach are emphasised. More so, I discuss the rationalization behind the selection of purposive sampling for this study and argue for using the case study as being best suited for my research. Additionally, I provide a detailed account of the data generation procedures that comprise focus group interviews, individual interviews, reflective journals, and student portfolios. Motivations for selecting the methods of data generation are presented. The importance of triangulation and how the data generation is fit for purpose is elucidated. Finally, the pilot study, data analysis process, rigour of the research such as the measure of trustworthiness and the ethical considerations for the study are expounded in this chapter.

3.2 Context of the study

This study centred on exploring university-community engagement (U-CE) by PSSTs through the study of a biology module. In this research, the need for the university to engage with a student community that resides on campus was motivated while the proposition for critical pedagogy, which will raise the consciousness of PSSTs, thereby making science more socially relevant and empowering, was advanced. Thus 36 PSST participants, who volunteered, were selected for this project. These participants were registered for a biology module that is called Biological Science for Educators 310 (EDBS 310) in the first semester of the 2017 academic session in the School of Education at a university in KwaZulu-Natal province of South Africa. The student community referred to students who resided on the campus. Twelve students from this group who did not study biology formed the university community of the sample.

Further, the 12 NBPSTs, who volunteered and self-classified, to have come from low socioeconomic backgrounds were purposely selected to form part of the case study. These NBPST participants received as little as R400 a month or no stipend at all for groceries from their families at home. While some of these NBPSTs were on funding, many of them sent part of their monthly allowance, which ranged between R800 to R1000, home to support their relatives who were poor or relied on the small amount of the social grants for the aged from the South African government. More so, these NBPST participants emerged mainly from quintile 1 and 2 schools. Quintile 1 and 2 schools are non-fee-paying schools in South Africa that are located in poor geographical areas in the country. Learners who attend these schools are usually severely economically deprived.

3.3 Paradigm

Bertram and Christiansen (2013) asserted that there had not been a consensus about the meaning of paradigm among researchers. According to these authors, some academics see paradigms in the light of qualitative and quantitative inquiry. However, Bertram and Christiansen (2013) argued that a broadly recognized description of paradigm but not homogenously acknowledged is that paradigm epitomizes the way an individual views the world philosophically, which is influenced by his/her thoughts, knowledge and actions. More so, “Critical studies as qualitative research in which the researcher is committed to exposing social manipulation and changing oppressive social structures and in which he or she may have emancipatory goals” (McMillan & Schumacher, 2014, p. 2). For this reason, my study was aimed at identifying the gaps in the pedagogy of pre-service teachers in a university and to argue for a pedagogy of conscience that is emancipatory. Johnson, Adkins, and Chauvin (2019, p. 1) explained that “a clear, focused research question must be supported by a strong conceptual framework and both contribute to the selection of appropriate research methods that enhance trustworthiness and minimize researcher bias inherent in qualitative methodologies”. The theoretical framework which is embedded in the critical paradigm ensured that my research questions could be addressed by the methodology and data analysis strategy of this study. The inclusion of the theoretical framework safeguards the trustworthiness of the study.

3.4 Approach

Kumar (2019, p. 16) summed up the qualitative process succinctly as:

> embedded in the philosophy of empiricism; follows an open, flexible and unstructured approach to enquiry; aims to explore diversity rather than to quantify; emphasises the description and narration of feelings, perceptions and experiences rather than their measurement; and communicates findings in a descriptive and narrative rather than analytical manner placing no or less emphasis on generalisations.

The importance of the qualitative approach in research has gained much relevance over the quantitative approach because it considers the postmodernism concept that views the world as having a variety of interpretations rather than a unanimous viewpoint (Flick, 2018). Additionally, postmodernism prescribes that there cannot be a precise explanation of any phenomenon (Elate, 2016; Nat, 2014). Moreover, Cooper and White (2011, p.6) contended that “qualitative research considers reality not as a fixed, objective, and constant construct but as a more fluid, ephemeral, and ever-changing thing”. The authors alluded to the fact that an individual makes his/her view about the world based on personal experience, cultural background, history and perception without having to conform to any general view. Thus, in a qualitative study, data are generated based on the assertions that there is no singularity of truth and that participants’ views vary which allows for a holistic understanding of the event under investigation.

Flick (2018) described qualitative research as an approach that focuses on people in their natural environment whose actions and perceptions about tangible matters, in their historical setting, are systematically gathered and analysed to produce empirical information. The author argued that qualitative research possesses four features that distinguish it from quantitative research. The four features of qualitative research, according to Flick (2018, p. 6), are as follows: “appropriateness of methods and theories, perspectives of the participants and their diversity, reflexivity of the research and the variety of approaches and methods in qualitative research”.

“Qualitative research is empirical research where the data are not in the form of numbers while quantitative research is empirical research where the data are in the form of numbers (Punch & Oancea, 2014, p. 3):

> One effect of the developments within qualitative methodologies has been to highlight the political nature of education and social research – the recognition that research, like other things people do, is a human construction, framed and presented within particular sets of discourses (and sometimes ideologies) and conducted in a social context with certain sorts of social arrangements, involving especially funding, cognitive authority and power. (Punch & Oancea, 2014, p. 145).

The preceding excerpt resonates with my study because it underscores the political nature of education and social research, which underpins my work. Therefore, the qualitative approach is apposite for my study.

3.5 Design

Research design is a strategy that a researcher utilizes to methodically gather and scrutinize the information required to provide answers to the research question of the study (Bertram & Christiansen, 2013). Research design is a plan that guides the research process to arrive at valid and reliable findings based on the research questions (Kumar, 2014). Research design locates the researcher in a space to obtain first-hand information that links the research questions to the data from the study (Punch, 2009). The author suggests that the following relationship, shown in Figure 7, exists between the research questions and the data in research design.

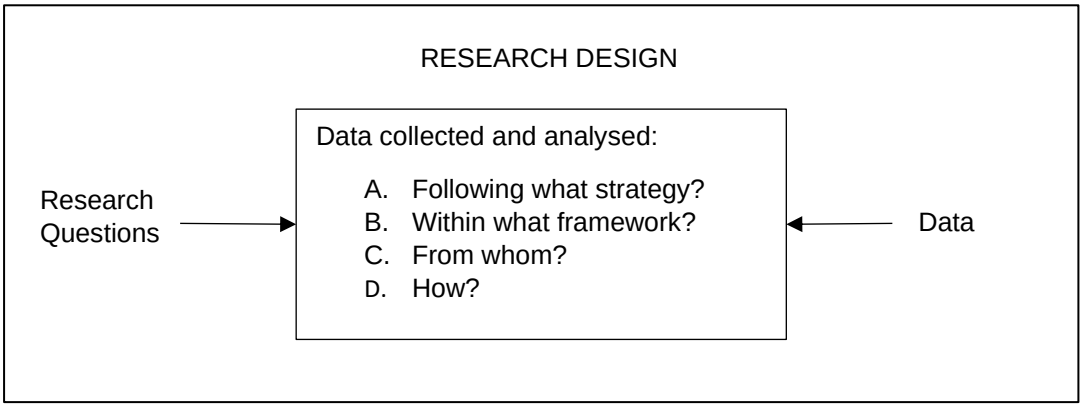


Figure 7: Research design connects questions to data
(Punch, 2009, p. 114)

Figure 7 summarises the interaction between the research questions and the data as these encompass the research design. For a research design to attain a level where data could be ready for analysis, components such as methods, structures, participants and techniques of conducting the research are essential.

Among the numerous investigative methods of conducting research, qualitative research design has been acknowledged as one of the most adaptable processes because of its richness in procedures and constructs (Astalin, 2013). The author asserted that phenomenology, grounded theory, ethnography, and case study are the four most prominent types of qualitative research designs. Creswell and Poth (2018), on the other hand, identify five kinds of qualitative research designs namely, narrative research, phenomenology, grounded theory, ethnography, and case study. For this research titled 'Exploring university-community engagement by pre-service science teachers through the study of a biology module, I employed the use of a qualitative case study research design.

Qualitative case study research offers the impetus for scholars to investigate intricate occurrences in their real-life environments (Baxter & Jack, 2008; Mills, Harrison, Franklin, & Birks, 2017). According to Mills et al. (2017), there exists a plethora of explanations and meanings of case study in the literature that has resulted in the misunderstanding of the concept. However, the authors contend that the definitions of Yin (2014), Stake (1995), and Merriam (2009) are among the most commonly engaged descriptions in literature by scholars. Yin (2014, p. 16) defined a case study as "an empirical inquiry that investigates a contemporary phenomenon (the case) in depth and within its real-world context, especially when the boundaries between the phenomena and context may not be clearly evident". For Stake (1995, p. xi), case study research is "the study of the particularity and complexity of a single case, coming to understand its activity within important circumstances" while Merriam (2009, p. 40) defines a case study as "an in-depth description and analysis of a bounded system".

Moreover, Yin (2014) stressed the details required, the procedure, the empirical nature and the setting in which the case study is conducted. Stakes (1995) submitted that the emphasis must be on the meticulousness about the context the case is being examined thereby considering the 'case' as an entity of study. Similarly, Merriam (2009), considered a case study as the detailed interpretation of a confined setup and

as a technique of an inquiry. It is noteworthy that these three definitions resonate with my study that explored the university-community engagement by pre-service science teachers through the study of a biology module. The study involved an in-depth investigation into the concept of U-CE, its implementation, requirements for its success, its influence on PSTs and its impact on pre-service science teachers' identity for future practice. This research was conducted in a university environment that represented the natural setting for the participants, which gave the study its context. Therefore, a case study design was suitable.

Furthermore, a case study "develops an in-depth description and analysis of a case or multiple cases where the unit of analysis could be an event, a program, activity or more than one individual" (Creswell & Poth, 2018, p. 104). A 'case', with regard to Creswell (2014, p. 493) may refer to "a single individual, several individuals separately in a group, a program, events, activities or a process consisting of a series of steps". The author also states that a case study occurs in a "bounded system which means that a case is separated for research in terms of time, place or some physical boundaries" (p. 493). In this study, the case refers to the study that explored university-community engagement by pre-service science teachers through the study of a biology module. The pre-service teachers who participated in my study were sampled from the 2017 set of undergraduate students who were studying towards attaining a Bachelor of Education degree. This group of students studied at the same university and shared the physical facilities provided by that university. Additionally, the PSST participants engaged with NBPST's participants who resided in the residence of the same university for 12 weeks.

3.6 Sample

In the qualitative research perspective, (Brooks, Bee, & Rogers, 2018, p. 105) described sampling as "the process of selecting participants for a research study from the wider population". Kumar (2014, p. 230), on the other hand, defined sampling as "the process of selecting a few (a sample) from a bigger group (the sampling population) as the basis for estimating or predicting the prevalence of an unknown piece of information, situation or outcome regarding the bigger group". The author adds that "a sample is a subgroup of the population that you are interested in" (p. 230). Flick (2014) agreed that the selection of samples in qualitative research depends

largely on characteristics that are identical to the sampling population rather than a formal sampling sequence. These features, according to Flick (2014), could relate to certain qualities that set the sampling population apart. Similarly, my sample for the PSSTs was selected based on considerations such as being in the same stream of pre-service science teachers (PSSTs) who offered Biological Sciences for Educators (EDBS 310) module in the 2017 stream in the same university under study. Similarly, the PSTs who participated as non-biology students were students who were self-classified as students from less privileged backgrounds and resided in the university campus residence. Cohen, Manion, and Morrison (2011) maintained that the sample size in the research procedure is dependent on the type of research design. The authors insist that many samples are required in survey research (quantitative research), while a small number will suffice for qualitative research. A case study that was used in this research is informed by the qualitative approach. The participants in this study were thirty-six biology students, who were referred to as pre-service teachers (PSSTs), and twelve students residing in the campus residences did not study biology modules and were called non-biology pre-service teachers (NBPSTs).

In general, qualitative sampling is purposive and done on purpose (Brooks et al., 2018; Nieuwenhuis, 2016). These participants who engaged in this study were purposively selected from the stream of pre-service teachers who were undergraduate students offering biology module EDBS 310 in the first semester of the 2017 academic year in that university under study. Similarly, the non-biology students who partnered with the PSST participants for the U-CE garden project were undergraduate students who lived on the university campus residence in the first semester of the 2017 academic session. These NBPST participants were requested to observe the U-CE gardens that were managed by the PSST participants. However, some of the NBPSTs who collaborated with the PSST participants volunteered to assist in doing some of the garden activities. Creswell (2014) gave a diagrammatic representation of purposive qualitative sampling that is shown in Figure 8.

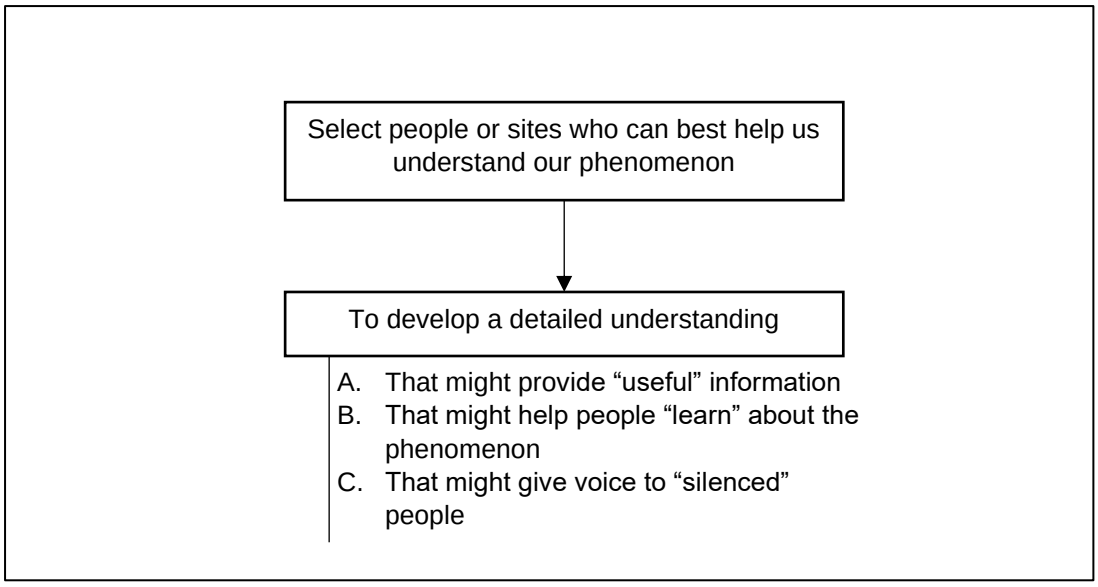


Figure 8: Purposeful qualitative sampling
(Creswell, 2014, p. 228)

Figure 8, according to Creswell (2014) revealed that samples are selected with the understanding that these participants will be able to give comprehensive information with regard to the phenomenon under study. These data, the author contends, may provide an expression for marginalized people. In this study, my participants were purposively selected after 2 briefings on the project and they volunteered after understanding the purpose of the U-CE project.

For Alvi (2016, p. 11), "a sample can be defined as a group of a relatively smaller number of people selected from a population for investigation purpose. The members of the sample are called as participants"

Convenience and purposive sampling techniques were used for this research. Convenience sampling entails selecting people as participants because of their proximity and ease of accessibility (Cohen et al., 2011). The biology students were purposively selected from the registered stream of students in the biology (EDBS 310) module of the first semester in the 2017 academic year. These pre-service teachers were invited to volunteer to participate in the study. The biology pre-service teachers were divided into six groups and each group managed a plot. Selected participants in this project, were required to critically reflect on the cultivation of a food garden which was established through this module Biological Science for Educators 310 (EDBS 310) over 8-12 weeks. The participants were available on some weekends/holidays and

they maintained food garden plots until harvest time. The PSSTs partnered with the 12 NBPST participants who observed and, in some cases supported in the maintenance of the food garden which was established by the pre-service science teachers for the same period of 8-12 weeks.

3.7 Data Generation

The use of several sources of data during a case study has been found to enhance the comparison of the research outcomes (Creswell & Poth, 2018; McMillan & Schumacher, 2014; Yin, 2014). To effectively gather evidence-based information, Bertram and Christiansen (2013) maintain that a researcher must be mindful of the following: firstly, care must be taken to select data generating methods that will be efficient, secondly, the methods must obtain data at affordable cost and time and thirdly, methods must be competently applied so that data generated will not be jeopardized in any way. As a result of the foregoing, I used multiple data generation methods for this study, took into consideration the factors of time and cost, made them adequate and affordable respectively, and ensured that data were adeptly collected, processed and stored for data analysis. In this study, four methods were used to generate data, namely, focus group interviews, individual interviews, reflective journaling and documenting details of gardening in a portfolio of evidence. Accordingly, the four methods offered extensive evidence, which, once analysed, assisted me in obtaining answers to the research questions of this study.

3.7.1 Data generation and instruments

In generating data, both the focus group interviews and the individual face-to-face interviews were conducted in a comfortable conference room and all were audio-recorded by me. The reflective journals and the portfolios of evidence were submitted at the end of the three months of the cultivation of the food gardens. The abbreviations and the diagrammatic representation (Figure 9) of the data generation are provided as follows:

Focus Group – FG

Individual Interview – II

Reflective Journal – RJ

Pre-Service Science Teachers – PSST

Non-biology Pre-Service Teachers – NBPST

Pre-Service Science Teachers' Portfolio of Evidence - PoE

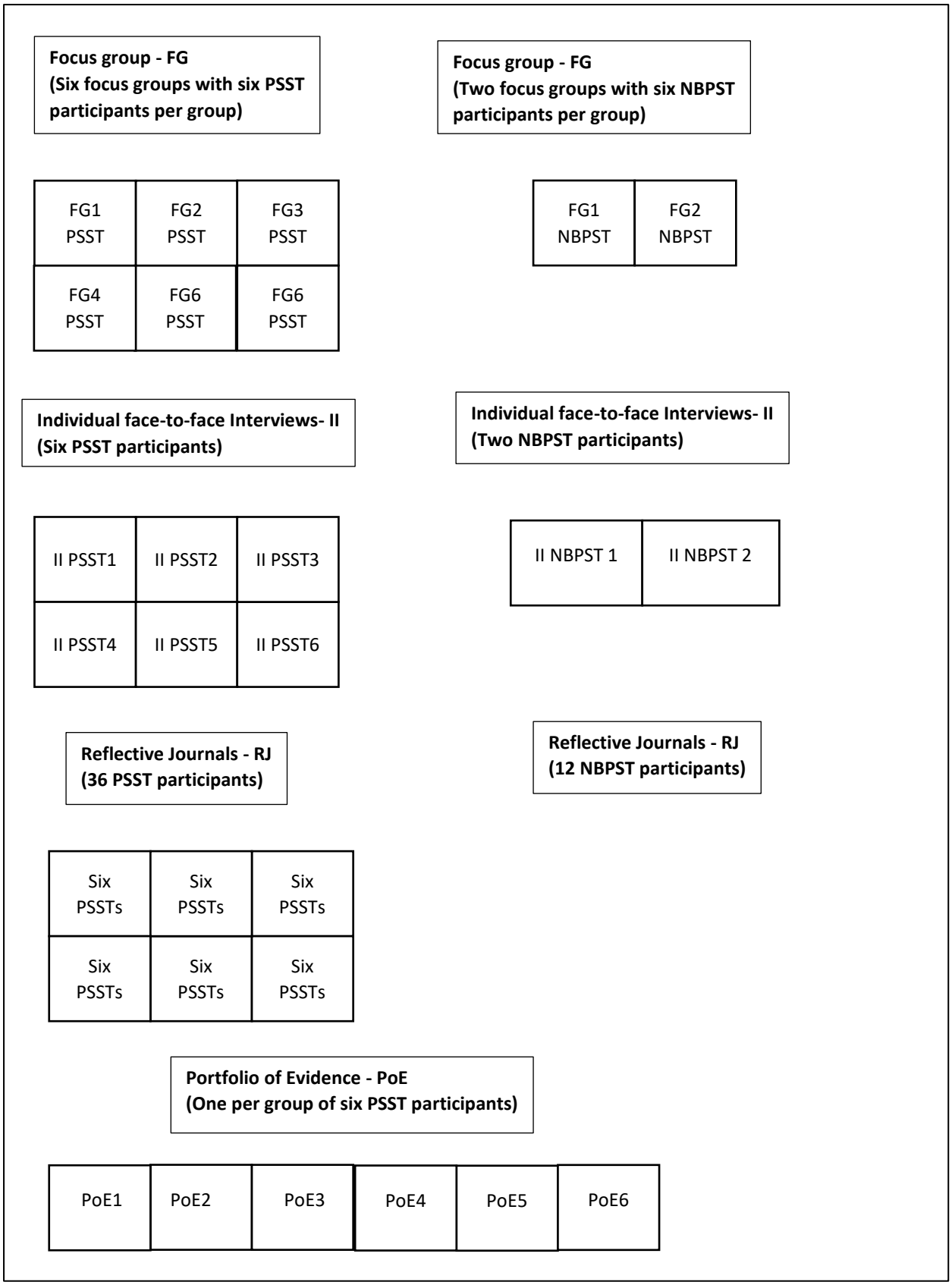


Figure 9: Diagrammatic representation of the data generation

3.7.1.1 Focus Group Interview (FGI)

According to Check and Schutt (2012), a focus group interview is a qualitative process that a researcher uses to encourage group discussion on the subject matter of the investigation by asking unstructured questions. The view by Check and Schutt (2012) is expatiated by Nieuwenhuis (2016, p. 95) who submitted that “the focus-group interview strategy is based on the assumption that group interaction will be productive in widening the range of responses, activating forgotten details of experience and releasing inhibitions that may otherwise discourage participants from disclosing information”. Marshall and Rossman (2011) argued that the interviewer in a focus group interview must ensure that a relaxed atmosphere is created to enable the participants to converse and articulate diverse opinions based on the phenomenon under study. Cohen et al. (2011, p. 436) confirmed that “it is from the interaction of the group that data emerge”.

For the FGI, participants were invited into the quiet conference room of the Research Commons in the library building of the university where the study was conducted. The venue was comfortable and I, the researcher, conducted the interview and facilitated the discussions. The participants became free to share their views and experience regarding what they knew and learned during the U-CE project. The FGI also prompted many of the members to speak when they noticed that some of their colleagues could express themselves with confidence which enriched the data obtained. The prompting of members during FGIs is corroborated by Hesse-Biber and Leavy (2011) who asserted that the response of one member of the group can arouse the other participants in FGI to provide more information that can enhance the patterns and categories data generated. A response by a participant could reduce vagueness and bring more understanding of the focused questions to the other participants.

Carey and Asbury (2016, p. 12) submitted that “focus groups reduce power imbalances between researcher and participants, thereby empowering them and facilitating research with them rather than on them”. In addition, FGI curtails the imposing voice of the interviewer, makes group participants free to engage in the focused questions and discussion thereby reducing the power disparity between the interviewer and the interviewees (Liamputtong, 2011; Raby, 2010). The issue of power

relations was taken into consideration during the focus group interviews which enabled the PST participants to voice their views unreservedly.

More so, Creswell (2014) recommended that data can be gathered from participants in an FGI with four to six members. The preceding insight is corroborated by Marshall and Rossman (2011) who concurred that a focus group can be as small as four and as large as 12 participants. The viewpoints of the scholars were considered when I constituted the focus groups for my study. There were six focus groups of PSSTs and two focus groups of NBPSTs with six members in each of the focus groups. This number ensured easy management of the group and made recognition of the recorded audio voices of the participants easy to identify during the transcription process.

The importance of taking notes accurately and audio recording of the participants' interactions and expressions in FGI have been highlighted. Kumar (2014) indicated that audio recording and the use of other methods of the recording of the FGI's, that best suit the interviewer, and will provide full details of the transcription of the data, are recommended. More so, if the audio recording is to be used, the interviewer should inform the interviewees and he/she must be familiar with the handling of the audio device and recorded interviews must be well stored and transcribed (Punch & Oancea, 2014). In this study, I utilized a voice recorder which I tested several times before using. The records of the interviews were downloaded into my computer and two other devices for safe storage and transcription.

Marshall and Rossman (2011, p. 149) concluded that "the strengths of focus group interviews are that this method is socially oriented studying participants in an atmosphere more natural than artificial experimental circumstances and more relaxed than a one-to-one interview". Further, the focus group interviews permitted me to obtain deep insights from participants on their views about the requirements, implementation, the influence of the garden project and ultimately the U-CE on the well-being of NBPSTs in a university campus residence and the impact on the identity of the PSSTs for their future practice. Appendices 5 and 6 provide the FGI schedule questions for the PSSTs and NBPST participants respectively.

3.7.1.2 Individual Interview

In a qualitative study, one of the most popular ways of data gathering is through interviewing (Drew, Hardman, & Hosp, 2008; Lichtman, 2010). According to Yin (2014) interviewing is one of the best ways to obtain data for a case study through unstructured questions and managed discussions between the interviewer and the participants. Hence, Ryan, Coughlan, and Cronin (2009) assert that individual interviews enable the interviewer to have more in-depth data from the participant since he/she provides insights, thoughts, and knowledge about the occurrence under study. McMillan and Schumacher (2014) explain that individual interviews are good for respondents who can easily contribute information and are confident enough to express themselves coherently. “One-on-one interviews are ideal for interviewing participants who are not hesitant to speak, who are articulate, and who can share ideas comfortably” (Creswell, 2014, p. 240).

One participant, who demonstrated the greatest insight and confidence, was purposely selected from each of the focus groups to participate in the individual interviews. There were six focus groups for the PSSTs and two focus groups for the NBPSTs that resided on the university campus. The total number of individual interviews conducted by me was eight. Thus, as the interviewer and researcher, I was able to probe the individual interviewees further about the U-CE project, vis-à-vis, the phenomenon under study and its transformational effects on both the PSST and NBPST groups alike.

Drew et al. (2008, p. 190) suggest some advantages and disadvantages of interviews. Table 5 outlines these advantages and disadvantages:

Table 5: Advantages and Disadvantages of Interviews
(Drew et al., 2008, p. 190)

Advantages	Disadvantages
Flexible – can be detailed to accommodate information needed	Expensive – can require a lot of travel as well as hours of training for assistants and development of interview protocol
Personal perspective of the respondent is provided. Meaning or feelings can be detailed.	Time consuming – often require travel or one-on-one format. Also require time to transcribe and interpret

Dialogue to clarify questions or responses is possible (and generally encouraged). This includes follow-up questions.	Vulnerable to manipulation by the respondent
Provide for greater depth of information	Require great skill and expertise of interviewer – intense concentration; the ability to listen, write, and anticipate questions; strong interpersonal interaction skills; note taking; maintaining neutrality while encouraging cooperation (i.e., not biasing respondent) Not appropriate for broad surveying of general attitudes or beliefs

In this study, I leveraged on the advantages delineated by the authors in Table 5 which afforded me the benefits of obtaining rich data from the participants during both the focus group interviews and the individual interviews. On the other hand, I mitigated the effects of the disadvantages, listed in Table 5 in the following ways: Firstly, I resided close to the university where the participants were studying which made it easy for me to access them without spending exorbitant funds on transportation to and from the sites of data gathering. Secondly, I structured my meetings with the participants for the individual interviews in such a way that my travel to the participants included a few trips, thereby reducing the cost of transportation. I dedicated six months of my study time to transcribe the data, to interpret the data, thereby eliminating the need to pay for these. Thirdly, I possess the experience of conducting interviews, which I had obtained during my Master's degree program in Science Education and while assisting some lecturers, as a research assistant in conducting interviews at the University of KwaZulu-Natal. Through these experiences, I mastered the skills of being neutral and honed my interpersonal and interaction skills with interviewees. In the case of notetaking, I relied more on my audio voice recorder which captured the voices of the participants including the tone of their voices.

Moreover, some of the prominent formats used for conducting interviews are structured, semi-structured and unstructured (Creswell, 2014; Drew et al., 2008; Merriam & Tisdell, 2016; Punch & Oancea, 2014). Consequently, Merriam and Tisdell (2016, p. 110) explained the differences among structured, semi-structured and unstructured interviews in Table 6 that follows:

Table 6: Interview schedule continuum
(Merriam & Tisdell, 2016)

Highly Structured/Standardized	**Semi-structured**	**Unstructured/Informal**
Wording of questions is predetermined	Interview guide includes a mix of structured interview questions	Open-ended questions
Order of questions is predetermined	All questions used flexibly and no predetermined order of questions	Flexible, exploratory
Interview is oral form of written survey	Usually specific data required from all respondents	More like a conversation
In qualitative studies, usually used to obtain demographic data (age, gender, ethnicity, education, and so on)	Largest part of interview guided by list of questions or issues to be explored	Used when researcher does not know enough about phenomenon to ask relevant questions.

In my study, I utilized the semi-structured format to guide my focus and individual interviews respectively in congruence with the preceding Table 6 as recommended by Merriam and Tisdell (2016). My schedule of questions, including the order, was not rigid and all the participants in the individual interviews were asked similar questions in order to elicit the patterns and categories of the data during data analysis. The individual interviews with the biology students allowed for more data to be gathered as they related to community engagement and empowerment of students. The NBPSTs were purposively selected, self-classified as emerging from low socioeconomic groups. The residence NBPSTs volunteered to be part of the research were willing and available to be interviewed through FGI and individual interviews (II). The schedule of questions for individual interviews can be found in Appendices 7 and 8 of this thesis.

3.4.1.3 Reflective Journals

Brookfield (2017) pointed out that reflective writing enables the documentation of experiences, thoughts, questions, ideas, and conclusions that signpost our learning journey. In addition, “the physical act of writing on paper cultivates a sustained focus on a stream of thoughts… When students are encouraged to reflect deeply about the automaticity of daily choices, they can begin to recognise how such decisions

ultimately shape persistence within the nuances of their academic and life trajectory" (Bandeen & Paul, 2018, p. 69). To be reflective, Bandeen and Paul (2018) agreed with Langer (2000, p. 220) who stated that "mindfulness is a flexible state of mind in which we are actively engaged in the recent, noticing new things and sensitive to context. When we are in a state of mindlessness, we act like automatons who have been programmed to act according to the sense our behaviour made in the past, rather than the present".

Therefore, through the maintenance of reflective journals during this study, the participants thought deeply about the food garden process and expressed their views in relation to their experiences. The participants were aware of the purpose of the project and used the knowledge and experience gathered for the duration of the study to express their feelings. The data generated during the U-CE project contributed to the answering of the research questions in my study. The PSSTs maintained reflective journals to document food availability and their experiences of being involved in the garden project. The twelve NBPST participants were grouped into six groups with two NBPST participants per group. Each group of two NBPST participants (residence students) worked with a group of six PSST participants on each plot to cultivate, maintain and observe the food garden plot until harvest. The activity was a partnership program between the PSSTs and the resident NBPST participants.

Atkins and Duckworth (2019) confirmed that through journal-keeping, deep thought on attitudes and experiences is initiated which can ultimately lead to social justice. Since this study is related to change that can emanate from enabling PSSTs to learn in a different (radical) way that can influence the pedagogy of science, raise the consciousness of health and nutritional well-being among NBPSTs and promote social transformation in the future, the use of reflective journaling was apposite. Using the reflective journal, the participants had the freedom of expression, which sometimes is inhibited in a group setting. The participants deeply expressed their opinions and learning experiences about the effects of the study on the well-being of the residence students and the attitudes of the PSSTs. Appendices 9 and 10 represent the guidelines for journaling used in this study to enable the participants to reflect on the project to provide data for the answering of the research questions.

3.7.1.4 Student Portfolio of Evidence

Sakhieva et al. (2015, p. 166) asserted that a portfolio "reflects the results of an individual educational activity of the student, the level of self-organization, the level of the development of the universal cultural and professional competencies that fully characterizes the student's identity, his information culture, communication characteristics, reflects his consistent and long-term educational". McMillan and Schumacher (2014) explained that students can be made to present their activities in a structured, organised and methodical manner for assessment purpose. The authors stressed that the compilation of students' work done in a portfolio, over a period of time, enables the lecturer to assess the strengths and weaknesses of the student's record in meeting the teaching and learning goals. Portfolios encourage reflective learning and inquiry (Elango, Jutti, & Lee, 2005). In this study, the development of student portfolios by the pre-service science teachers enabled them to reflect deeply and document their learning and experiences in written and pictorial forms. This strengthened the credibility of the research data and enhanced the triangulation of data.

3.7.2 Data generation methods fit for purpose

Bertram and Christiansen (2013, p. 203) concede that "the method of data collection that must be 'fit' the kind of data the researcher wants to collect and how he or she plans to analyze it".

Table 7: Outline of the research questions and methods/instruments used for data generation

Research Questions to be answered	Participants	Methods/instruments
Research Question One: How do pre-service science teachers implement university-community engagement through their study of a Biology module? **Research Question Two:** What are pre-service science teachers' views about requirements for effective	36 volunteers were purposively selected because they were pre-service science teachers who registered for Biological Sciences for Educators (EDBS 310) module who were clustered into six groups of six PSST participants. Also, 12 volunteers who were non-biology students residing in the residence and classified as students from the low	Focus group interviews

university-community engagement through a Biology module?	socioeconomic background were purposively selected and were grouped into two groups of six NBPST participants	
Research Question Three: What are pre-service science teachers' views about how university-community engagement can influence the well-being of students at a university? **Research Question Four:** How does engaging in a university-community engagement project influence pre-service science teachers' professional identity for their future practice?	Six PSST participants purposively selected (based on their rich knowledge and contributions in the focus group interviews about exploring U-CE through PSSTs using a biology module) to strengthen the data gathered while two NBPST participants were also purposively selected for their insight with regard to the phenomenon of the case study during the focus group interviews	Individual face-to-face interviews
	36 PSSTs and 12 NBPSTs were given formatted reflective journals to document the reflection of their experiences about the U-CE project.	Reflective journals
	Portfolio of evidence was developed by the six groups of the PSSTs only. The six groups of the PSSTs were given 8-12 weeks (period of the project) to complete the portfolio of evidence.	Portfolio of evidence

Table 7 provides an outline of the research questions, the methods used for collecting the data and also the instruments. As earlier indicated in chapter 1 of this thesis, four research questions guided this study which are also stated in the first column of Table 7. To answer these questions, the following steps were taken: 36 PSST participants were placed in six groups of six members and 12 NBPSTs were clustered into two groups of 6 members for the focus group interviews. Thereafter, six and two participants from the PSSTs and NBPSTs, respectively, who showed an in-depth understanding of the study were purposefully selected for the individual face-to-face interviews. Furthermore, all the participants were given reflective journals during the eight to 12 weeks of the research to record their reflections about the U-CE project while the PSST participants in their groups kept a portfolio of evidence, with pictures, about the stages of the project together with operations carried out during the study (Refer to Figure 9 for a schematic representation).

3.8 Triangulation

Triangulation is defined by Lichtman (2010, p. 246) as “the use of several methods or strategies to gather data with the purpose of increasing the credibility of findings or of obtaining a more substantive view of reality”. Creswell (2012) described triangulation as a process of confirming data that are generated from various methods or verifying the themes and categories that emerge from the various sources of data generation in a qualitative study. Kumar (2014, p. 386) agrees with the preceding authors about the definition of triangulation and he explains triangulation as follows:

> Triangulation involves the use of the same set of data from multiple sources to best achieve the objectives of your study. It is based upon the belief that use of the same set of data, collected through different approaches to draw conclusions, and its examination from different perspectives will provide a better understanding of a problem, situation, phenomenon or issue.

Through the use of multiple sources of data, credibility and justification of evidence are enhanced (Check & Schutt, 2012; Cohen et al., 2011; Creswell & Poth, 2018; Marshall & Rossman, 2011; Oliver-Hoyo & Allen, 2006; Yin, 2014). In view of the benefits of triangulation as alluded to by scholars cited in this section, I utilized the concept of triangulation to consolidate the outcomes of the data sources. I used focus group interviews, individual interviews, reflective journals and a portfolio of evidence to generate data for this study. The PSST participants responded to my schedule of questions through the interviews, reflections, and record-keeping of the food garden project, both with texts and pictures in their portfolio of evidence. On the other hand, the NBPST participants, who formed the community, participated in the interviews, maintained reflective journals but did not develop the portfolio of evidence because the cultivation of the food gardens was largely done by the PSST participants. The data from the various sources were corroborated to determine the congruence and similarities. The data generated, using the multiple sources were coded, categorized and thematised. Check and Schutt (2012, p. 267) provided insight into credibility by asserting that “the important thing to understand is that no one data source can give you a whole and accurate picture of what is happening” in a research study. Thus, by using many sources of data in my study I was able to increase the authentication of the data collected which made the findings credible and trustworthy.

Some authors concede that there exist four types of triangulation which are termed Data triangulation, Investigator triangulation, Theory triangulation, and Methodological triangulation. (Flick, 2014; Janesick, 1994; Yin, 2014). More so, the fifth type of triangulation was identified as “environmental triangulation” (Guion, 2002, p. 1). To elaborate on the five kinds of triangulation, Lichtman (2010, p. 229) explained as follows:

> Most writers think about data triangulation, in which data from different sources are collected. Investigator triangulation involves the use of different investigators, while theory triangulation involves the use of multiple perspectives. Multiple methods are the mainstay of Methodological triangulation. Finally, using different locations or settings is the key element of environmental triangulation. I believe that triangulation makes qualitative research more objective and less subjective – in order words, more scientific.

Fusch, Fusch, and Ness (2018) argued that students of research usually confuse data triangulation with methodological triangulation. The authors concur that data triangulation uses the collaborations of data generated over time at different places and with participants while methodological triangulation corroborates data within a method or between methods and across methods. Therefore, within method triangulation considers data from a qualitative study such as a case study using data from sources such as interviews and focus groups whereas without can be collecting data from both qualitative and quantitative research or mixed methods (Flick, 2014; Fusch et al., 2018)

Thus, my study selected the method of methodological triangulation. Data from focus groups, individual interviews, reflective journals and the portfolio of evidence were carefully corroborated to better have an in-depth understanding of the phenomenon as expressed by the participants which enabled me to analyse the data accordingly.

3.9 Pilot study

Doody and Doody (2015, p. 1074) assert that “a pilot study contributes valuable information to assist researchers in the conduct of their study. Conducting a pilot study provides the researcher with the opportunity to develop and enhance the skills necessary before commencing the larger study”. More so, a pilot study, in the context

of a qualitative study, is crucial in the determination and suitability of potential participants and for making interview questions unambiguous to the participants (Majid, Othman, Mohamad, Lim, & Yusof, 2017). A pilot study was done in 2016 with 12 PSSTs and two NBPST participants. The PSST participants were registered for the Biological Sciences for Educators (EDBS 310) in the first semester of 2016 academic year at the university where my research was conducted. The questions in the reflective journals were designed to be done weekly for the duration of the study, for the purpose of the pilot study. However, I observed that the participants preferred to do the reflection twice, at the beginning and at the end of the period when the gardens were ready for harvest respectively. This observation was corrected in the study.

3.10 Data analysis

Cousin (2009, p. 31) argued that "qualitative data analysis explores themes, patterns, stories, narrative structure and language within research texts (interview transcripts, field notes, documents, visual data, etc.) in order to interpret meanings and to generate rich depictions of research settings". The author stresses that data must be well handled and focused during gathering and analysis to produce theoretical findings. Creswell and Poth (2018) underscored the fact that qualitative data analysis goes beyond scrutinizing text and image data. The authors contend that data analysis is a helical process that involves the systematic organization of the data, meticulous reading of the data, coding, identifying categories, developing themes, representing and interpreting the data accordingly.

It is significant to note that qualitative data analysis, including interpretation, is not a linear process but an iterative (back and forth) or circular process (Hesse-Biber & Leavy, 2011; Lichtman, 2010). Figure 10 and Figure 11 are diagrammatic representations of data analysis processes, as iterative and spiral, and alluded to by Creswell (2014, p. 261) and Creswell and Poth (2018, p. 186) respectively.

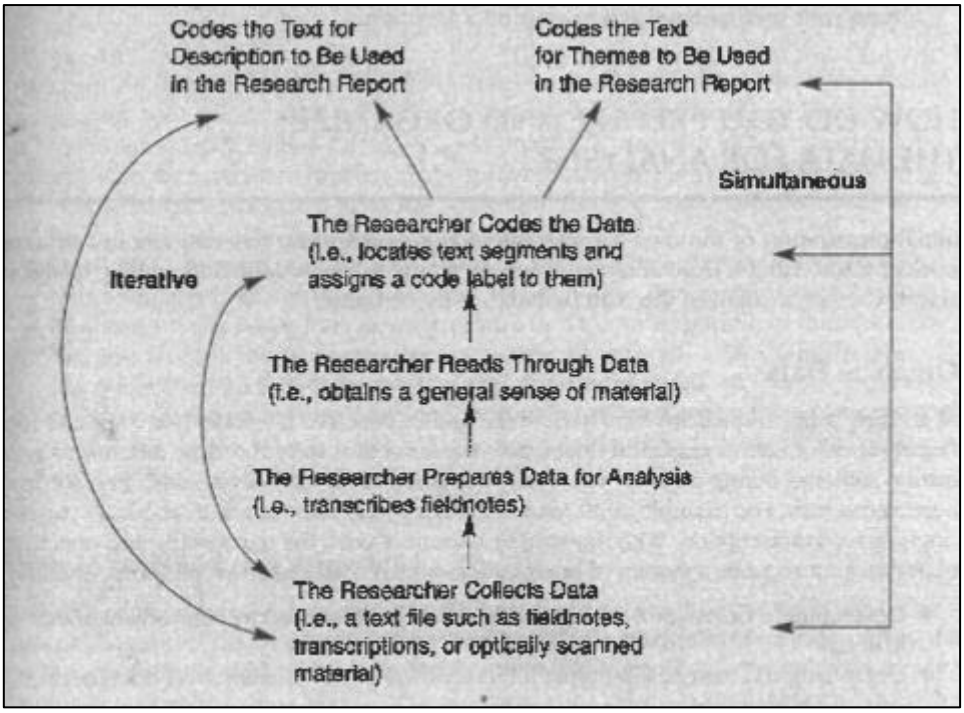


Figure 10: Qualitative Process of Data Analysis
Creswell (2014, p. 261)

According to Figure 10, the researcher collects qualitative data using different strategies. This evidence-based information is transcribed and read through several times to make meaning out of it before it is assigned codes in line with the phenomenon under study and the research questions to be answered by the study. “A code is a qualitative inquiry is most often a word or short phrase that symbolically assigns a summative, salient, essence-capturing, and /or evocative attribute for a portion of language-based or visual data” (Saldaña, 2016, p. 4). The short phrases of codes as explained by the author are categorized and organized into themes in order to answer the critical questions of the study. In addition, Figure 10 also indicates that the process is not one way or linear because the researcher must go back and check that the codes and categories conform to the raw data generated from the various sources. Simultaneously, the themes should synchronise with the codes and articulate with the literature and theoretical framework of the study.

Therefore, Creswell (2014, p. 262) concurred that the “qualitative process of data collection is an inductive process, going from the particular or the detailed data (e.g. transcriptions or typed notes from interviews) to the general codes and themes”. Principally, qualitative research is an inductive process that ensures that data are

organized into groupings to determine the patterns and connections among them to elucidate a new phenomenon or expatiate on an already existing occurrence (Court, Abbas, Riecken, Seymour, & Le Tran, 2018; McMillan & Schumacher, 2014). In this study, the data from the interviews were transcribed verbatim in order to capture the exact voices and body expressions of the participants before coding was done. I immersed myself in the understanding of the data transcribed, data from the reflective journals and portfolios of evidence, and to have a good sense of the responses in line with the answering of the research questions before coding and establishing the patterns and relationships among the data.

The following Figure 11 explains the spiral process of data analysis:

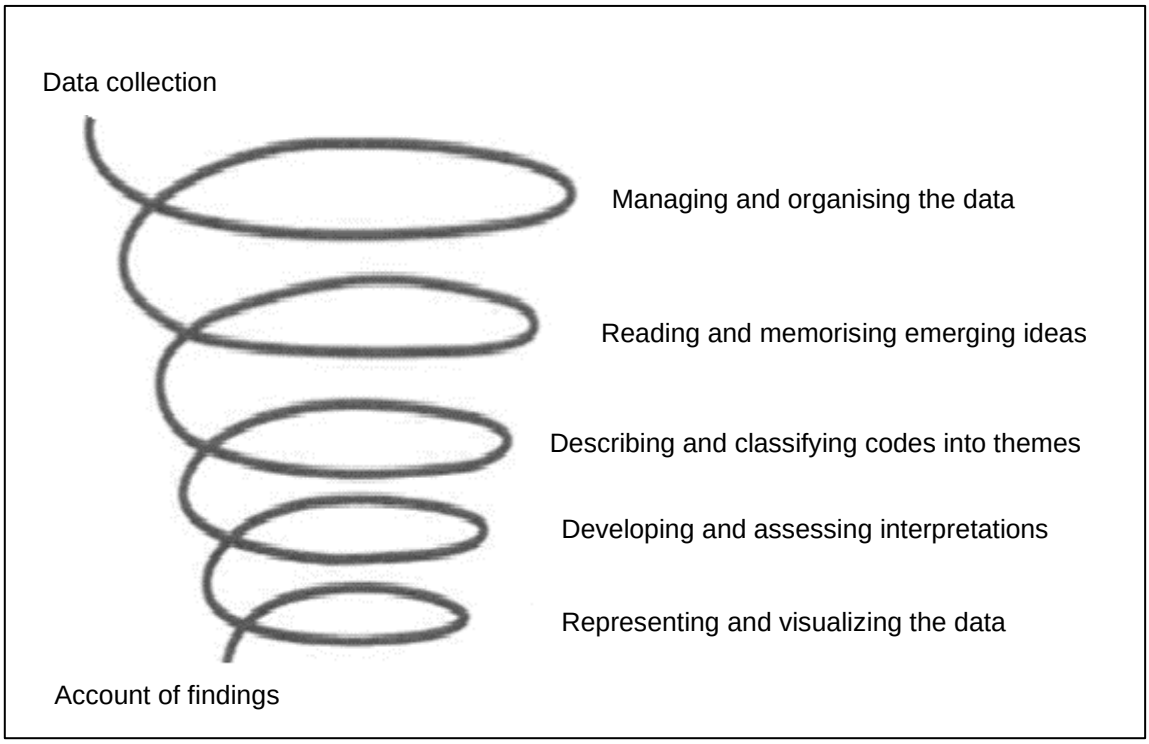


Figure 11: The Data Analysis Spiral
(Creswell & Poth, 2018)

Similarly, Figure 11 depicts the data analysis spiral process. Figure 11 reveals that data analysis must begin with the collection of the data. Since the data could be voluminous both text and images, data needed to be managed and organized in such a way as to extrapolate the main ideas that will form the codes and themes as the process of data analysis unfolds along the spiral. At the emergence of the theme, the findings must be accounted for and they must be in congruence with the raw data collected. This process according to Creswell and Poth (2018) is instinctive, sensitive,

with the belief that there is no absolute truth and participants have a divergence of opinions.

At the initial stage of the analysis, I used computer software called Nvivo to code the data from the focus group interviews and individual interviews after transcribing the audio information. Later, I switched to the manual process to complete the coding before I generated the categories and the themes to apply my mind to the categorization procedure. Simultaneously, the coding of the reflective journals and portfolio of evidence were manually coded while the categories and themes materialized. More so, Patton (2015, p. 531) argued the use of computer software may not be as productive as researchers may think because the "real analytical work takes place in your head". I agree with this notion because the data analysis is qualitative analysis and is iterative where you go back and forth in your thoughts as you make sense out of the myriads of data at your disposal.

Moreover, content analysis was used to analyse the data generated from this study. Kumar (2014, p. 318) defined content analysis as the process of "analysing the contents of interviews or observational field notes in order to identify the main themes that emerge from the responses given by your respondents or the observation notes made by you". Bauer (2000) contended that content analysis can be used for analysing any written information while Flick (2014) argued that a theoretical framework is usually applied when categorizing textual data to give more meaning and ultimately summarizing the volume of data generated by the researcher. The content analysis encompasses the methodological synopsizing of data that are written to extrapolate the main ideas and important information from the sets of written evidence available to the researcher (Cohen et al., 2011; Schreier, 2014). According to Cohen et al. (2011, p. 563), data generated via content analysis used for content analysis are "in permanent form (texts) verification through re-analysis and replication is possible".

As a result of the foregoing arguments by the scholars, I employed the use of content analysis to reduce the volume of data derived from focused interviews, individual interviews, reflective journals and the portfolios of evidence. I systematically scrutinized the main ideas, in line with the theory and literature related to the phenomenon, coded, categorized the codes and generated themes required to provide answers to the research questions of the study.

3.11 Rigour of the research

3.11.1 Measure of trustworthiness

Mandal (2018) admitted that for a qualitative study to be trustworthy, adequate evidence with different procedures must be provided and done respectively, to confirm the veracity, consistency, and significance of the study. Credibility, transferability, dependability, and confirmability have been identified as essential to justify the findings in a qualitative study thereby ensuring trustworthiness (Bloomberg & Volpe, 2019).

3.11.2 Credibility

One of the most vital processes of achieving credibility in qualitative research, which most scholars agree with is by member checking (Culver, Gilbert, & Sparkes, 2012). “Member checking is a qualitative process during which the researcher asks one or more participants in the study to check the accuracy of the account” Creswell (2014, p. 7). In this study, I conducted member checking to increase the credibility of the research. PSST and NBPST participants were invited to a session where we reviewed the interview transcripts, other data and themes that emerged from the study together. I re-played the audio-recorded interviews for the participants to confirm their voices vis-à-vis the transcripts of the transcribed interviews. Moreover, I held several debriefing sessions with my supervisor to review and interrogate the data thereby making sure that my data are credible as required.

3.11.3 Transferability

Johnson et al. (2019, p. 7) asserted that for qualitative research to be transferable, the investigator must “provide detailed contextual information such that readers can determine whether the results are applicable to their or other situations”. Kumar (2014) supported the preceding authors’ position by affirming that the extent to which a qualitative study is painstakingly and comprehensively done can influence its replication in another context. In view of the foregoing, I was meticulous in recruiting my participants, collecting the data, transcribing, analyzing and noting every detail related to the study. In addition, I integrated the theoretical framework with other scholars’ work expansively and I provided thick descriptions of all these activities to make the study transferable in another similar context and for further research.

3.11.4 Dependability

Dependability "emphasizes the need for the researcher to account for the ever-changing context within which the research occurs" (Lichtman, 2010, p. 228). The researcher must take responsibility for any variation that takes place during the study and how the change impacts the perspective of the research. During the study, I was able to monitor every change because I had effective communication channels with my participants and enjoyed maximum cooperation from them.

3.11.5 Confirmability

According to Bertram and Christiansen (2013, p. 201), "confirmability refers to the degree to which the analysis of the researcher can be confirmed by someone else, either a different researcher or the reader. Making data analysis transparent is one way of increasing confirmability". I ensured that my data was transparent and there was no falsification of any kind. I also transcribed the interviews verbatim which can be confirmed by any person or researcher. Confirmability was enhanced by engaging my supervisor to read the transcripts and other data sets and guide the analysis.

3.12 Ethical issues

Strydom (2011, p. 113) defined ethics as the "mutual trust, acceptance, cooperation, promises, and well acceptable conventions and expectations between all parties involved in a research project". The dignity which encompasses how people think to socialise and live is described as ethics by Kvale and Brinkmann (2009). Thus, as a researcher, I took the dignity of my participants and the gatekeepers into account during this study. My study considered a variety of ethical issues to respect the rights of the people concerned in the study.

3.12.1 Permission to conduct the study

The permission to conduct a study in a place is crucial. Hesse-Biber and Leavy (2011, p. 201) stated that "settings often contain gatekeepers whose approval is crucial to gain access and acceptance, formal gatekeepers grant you formal permission to enter a setting". The authors added that the gatekeeper could be the head of the institution or organization which will serve as the site for the conduct of the study. Sood (2016) emphasised that the necessary details of the study must be made available to the

gatekeepers to secure their confidence, support, and approval. Consequently, the gatekeeper for my study was kept well-informed of my research by writing. After informing the gatekeeper with every necessary detail of my study, I was granted permission to conduct the study. Further after this approval from the gatekeeper, I applied for ethical clearance from the Human and Social Sciences Ethics Committee of my university. Appendix 1 is a copy of the gatekeeper's permission given for me to conduct the study.

3.12.2 Informed consent from participants

According to Dooly, Moore, and Vallejo (2017), the researcher and/or research team will always obtain informed consent from all parties involved in the research prior to implementing the research project. The informed consent should explain the intricacies such as the rationale for the study, hazard, methodology of the research and the time demand on the respondents, who are involved in the research (Dooly et al., 2017; Drew et al., 2008). Significantly, "the informed consent process constitutes an exercise of the principle of autonomy and must be carried out free of persuasion, manipulation, and coercion. The document must be clear, precise and understandable for the population where it will be applied" (Acevedo Pérez, Rapiman, Cáneo Orellana, & Rueda Castro, 2017, p. 23). Thus, written informed consent that was endorsed by my supervisor was given to the pre-service teacher participants to sign. The purpose, objectives of the study, methods of data collection, the participants' choice to decline or withdraw from the study without any consequence were detailed in the informed consent document. See Appendices 2 and 3 for informed consent documents.

3.12.3 Anonymity and confidentiality

McMillan and Schumacher (2014) agreed that the identity of the participants and the location of the study must not be made public or printed. The authors stress the need to anonymize the identities of the place where the study is being conducted and the participants to maintain the trust of the respondents. "Privacy refers to individuals' right to control the disclosure of what they deem personal or non-public information about themselves. This is a legal provision in most countries to protect the right to privacy" (Punch & Oancea, 2014, p. 68). Hammersley and Traianou (2012) insisted that the recognition accorded to the privacy of a person guarantees confidentiality.

Consequently, I ensured that the rights to confidentiality of the PSSTs and the NBPSTs' participants who took part in my study were respected. Codes such as FGPSST1, IINBPST3 indicating focus group interview pre-service science teacher 1 and individual interview pre-service teacher 3 respectively, were allocated to the participants to assure their anonymity. The university where the study was conducted has also not been named in the writing of this thesis. Furthermore, where image data were used, in the case of photographs, faces of the participants were blurred to hide their identities. Names of participants were not revealed in the portfolios of evidence. Yin (2014) concluded that participants' confidentiality must be protected to the extent that the respondents must not be unsuspectingly put in a position where their details could be assessed by the researcher or any other researcher for future research. Thus, I complied with the foregoing assertion and did not archive the details of the participants for my future study or for another researcher without the intention of seeking their consent.

3.12.4 Accuracy

Qualitative research is a methodological process that does not have a rigidly regulated procedure but possesses measures that must be in place to ensure the accuracy of the findings during the data collection and interpretation (Taylor, Bogdan, & DeVault, 2015). Nvivo, a software developed to support the analysis of qualitative research, makes coding of data faster, saves the time of the researcher and enhances the accuracy (Bazeley, 2009; Zamawe, 2015). I utilized the 11th version of the Nvivo software for coding of the transcribed data and generating of their categories before continuing with the manual process of analysing. During the manual process, I coded the data from the reflective journals and also the portfolios of evidence. I also held regular consultations with my supervisor during the stages of the data analysis after she had reviewed my submission of work.

3.12.5 Data use and disposal

The use of data and its disposal were outlined to the participants and the gatekeepers in writing. These stakeholders were informed that the data would only be used for my Doctoral study and academic publications to contribute to the body of knowledge. Additionally, the data would be stored in a safe place that is agreed to by my promoter and supervisor within the university where I am registered as a Doctoral student, for a

period of five years. The disposal of the data would be done after five years and in this way, transcripts of the interviews, copies of the research journals and the portfolios of evidence would be shredded. The audios of the interviews would be permanently deleted from all storage devices including the audio recorder and any external drive where they would be stored.

3.13 Limitations of the study

This study was conducted in one university and it was specific to that context, thus, it may not be generalized. Some participants withdrew from the study because they complained about having too much workload from their academic work. However, I had envisaged this in advance of the study, therefore I had recruited more participants at the beginning of the study to mitigate the challenge created by the attrition of participants. This study is a case study and thus, more research will be needed to expand the study in other contexts.

3.14 Conclusion

In this chapter, I discussed the details of the qualitative research methodology that I used to conduct my study. The context, paradigm, and design that informed the research were elaborated. More so, explanations were provided on the process of sampling, data generation including data analysis. The measures chosen to ensure the trustworthiness of the findings were ventilated. Further, the importance of ethics and the steps that were taken by me to comply with the high ethical standard was also elaborated in this chapter. I also outlined the limitations related to this research. In the following chapter, data analysis and presentation using the literature is detailed.

CHAPTER 4: DATA PRESENTATION AND ANALYSIS

4.1 The preamble to data presentation:

In this study, data was generated through the activities of pre-service science teacher (PSST) participants who studied a module called Biological Science for Educators 310 (EDBS 310), as well as non-biology pre-service teacher (NBPST) participants, who resided in the residence of a university campus. The pre-service science teacher participants engaged in food gardening activities which were an aspect of one of the topics in the EDBS 310 module course outline called 'Nutrition'. The PSSTs who studied the EDBS 310 module were expected to develop appropriate knowledge, skills, values, and attitudes about nutrition and living organisms.

The module lecturer, Mr. Roberts (pseudonym) for EDBS 310 provided limited guidelines on how students, offering the module, should carry out self-directed research. Students were informed to apply scientific knowledge of nutrition to food gardening to understand how health and nutritional issues of students residing on a campus residence could be addressed. In order to give the students more leverage, the module lecturer organized a field trip to an Eco-school where broader guidelines for choosing plants to cultivate with a view to addressing health challenges were highlighted by permaculture and indigenous knowledge experts.

As a researcher, I recruited participants from the population of students studying an EDBS 310 biology module who were guided by the lecturer of the module and who visited the Eco-school where they were enlightened about food gardening procedures and benefits of food crops to health. In addition, the planting of a variety of food garden crops was demonstrated to the students, some of which included indigenous crops. I served as an assistant on the trip to the Eco-school in 2017 and I had the first-hand experience of the pedagogy and methods of gardening used by permaculture and indigenous knowledge instructors, who were experts in their fields.

The university-community engagement (U-CE) project involved the following steps: PSST participants who studied a biology module carried out independent research, on the nutritional needs (related to health) of students studying in that university. This

research revolved around the cultivation of food gardens by six groups of PSSTs. This investigation also extended to the undergraduate NBPSTs who lived in the university campus residence, and who did not study biology. The research focused on nutrition and healthy living. Participants utilized the information about the needs of university students and based on this, they selected food garden crops to plant, which would potentially address health matters or needs through nutrition. Thereafter, they worked in groups to establish food gardens within the university premises and nurtured them for 8-12 weeks.

As part of the research methodology, two NBPSTs, who had dwelt in the university residence, observed and worked with one of each of the six groups of PSSTs who had established food gardens. The PSSTs nurtured the food gardens from the stage of sowing seeds/planting seedlings to maturity. There were six groups of PSSTs, and each group managed a plot with two NBPSTs observing and engaging in the food gardening activities two to three times a week. Data were gathered through focus group interviews, individual interviews, student portfolios, and reflective journals. During the exercise, the PSST participants had divided responsibilities for growing the food crops and they taught the NBPSTs content knowledge and skills about food gardening, its importance and the nutritional and health benefits of the food gardens.

Table 8 describes module guidelines for activities in which the two sets of participants engaged.

Table 8: Module guidelines for activities done by participants

Activity	Biology PSSTs	Non-biology PSTs
Self-directed research on nutritional and health benefits of food gardens done prior to establishing the garden plots.	Engage in self-directed research to determine nutritional needs to manage health challenges and food insecurity.	Not applicable.
Soil preparation.	Prepared soil for planting in garden beds. (PSSTs had received training on soil preparation from	Assisted the PSSTs in soil preparation. (Learned skills and knowledge about soil preparation for food gardening from PSSTs)

	permaculture and IK experts during a field trip)	
Planting a variety of food gardens crops to address a health condition.	Planted a variety of food garden crops such as carrots, beetroot, and spinach, with a view to responding to a nutritional health challenge.	Assisted the PSSTs during the planting of the food crops.
Maintenance of food garden (pest control, providing water, tilling the soil, until maturity. (Duration: 8-12 weeks).	Regularly maintained the food garden until maturity (8-12 weeks).	Assisted the PSSTs voluntarily to maintain the food gardens.
Teaching Non – biology PSTs about the cultivation and importance of food gardens to nutrition and health when they visited to observe the food garden.	Engaged in teaching Non-biology PSTs.	Non -biology PSTs received tutorials from PSSTs on the cultivation and importance of food gardening to nutrition and health.
Developing of Portfolio of evidence.	Developed portfolios of evidence.	Not applicable.
Observation of the crops in the food garden.	PSSTs recorded progress events, including photographs, related to progress or lack thereof, of growth of plants. This was recorded on the portfolios of evidence (PoEs).	Observed the food gardens and helped the PSSTs with some duties such as irrigating and harvesting of the garden vegetables.

Figure 12 to Figure 17 is a selection of photographs from one of the portfolios of evidence (PoE) developed by a biology PSSTs group. They illustrate the stages of food gardening from soil preparation to harvesting.

Figure 12: Weeding of the food garden site

Figure 13: Mapping out the food garden site

Figure 14: Soil preparation in progress

Figure 15: Applying compost to the soil

Figure 16: Irrigation of food garden crops

Figure 17: Crops/vegetables ready for harvest

This is a brief background of PSSTs' activities related to the U-CE project. Against this background, I explored PSSTs' U-CE, using the following four critical questions.

Research Question One:

How do pre-service science teachers implement university-community engagement through their study of a biology module?

Research Question Two:

What are pre-service science teachers' views about requirements for effective university-community engagement through a biology module?

Research Question Three: How does university-community engagement by pre-service science teachers influence the well-being of students at a university?

Research Question Four: How does engaging in a university-community engagement project influence pre-service science teachers' professional identity for their future practice?

Data were distinguished based on their sources and the use of abbreviations in this respect are as follows:

Focus Group Interview – FG

Individual Interview – II

Reflective Journal – RJ

Pre-Service Science Teachers – PSST

Non-biology Pre-Service Teachers – NBPST

Pre-Service Science Teachers' Portfolio of Evidence - PoE

The following are examples of the codes and their interpretations:

1. FG1 PSST1: Focus Group Interview 1 Pre-Service Science Teacher Participant 1
2. FG2 NBPST3: Focus Group Interview 2 Non-biology Pre-Service Teacher Participant 3
3. II PSST2: Individual Interview Pre-Service Science Teacher Participant 2
4. RJ1 NBPST4 – Reflective Journal Group 1 Non-biology Pre-Service Teacher Participant 4
5. PoE 5 – Portfolio of evidence of Pre-Service Science Teachers: group 5

4.2 Research Question One: How do pre-service science teachers implement university community engagement through their study of a biology module?

Pre-service science teachers' implementation of food gardening was made possible through their construction of knowledge about food gardening, by working collaboratively, by surveying the university student community to determine their nutritional needs to manage health-related conditions, food insecurity and the researching about food garden crops that could be used to alleviate these situations.

They also developed problem-solving skills to enable them to progress in the U-CE activity. The following themes emerged from data to Research Question 1:

Theme 1:

- **Acquire the knowledge of food gardening**

Pre-service science teacher participants acquired knowledge about food gardening from multiple sources, and this enabled them to engage in U-CE, as is evident by the following excerpts:

Yes. And… and, we learned hmm… indigenous ways of planting. Nowadays technology is much more in use than indigenous ways, so this project has also helped us to remember and redo the indigenous ways. (FG1 PSST3)

And we had a chance to go to eco-school and experienced biodiversity and ecosystems and… got some information. (FG3 PSST2)

The plants that we decided to plant are indigenous and, they were also organic as we used natural fertilizers consisting of cow dung… (PoE5)

Yes. It taught me the permaculture method of farming which I really had no idea about. (RJ PSST5)

Pre-service science teacher participants had interacted with an Indigenous Knowledge (IK) holder and permaculture experts to construct knowledge about food gardening. They learned the value of utilizing environmentally friendly products such as organic compost. In addition, they were enabled to implement the U-CE project by learning indigenous ways of food gardening. Within the South African context, researchers have explored PSTs learning from IK holders. Govender, Mudaly, and James (2016) contended that PSTs gained new knowledge and insights after interacting with IK holders regarding a variety of indigenous plants, cultivation methods of some of these local plants and the control of pests in the garden or farm. The PSTs, the researchers emphasized, concurred that the knowledge held by the IK holders is as authentic as that possessed by the Western educators. Therefore, there is a need to integrate Western and indigenous information for agrarian and environmental sustainability.

Other researchers, such as Mudaly (2018) and Mudaly and Ismail (2013), argued that PSSTs value learning about IK as part of the science teacher education curriculum.

This study provided evidence that through U-CE projects such as food gardening, PSSTs can acquire knowledge through unconventional means which transcend prescribed content embedded in the curriculum of the university, as well as the school curriculum, which governs their teaching.

Theme 2:

- **Collaborative effort of pre-service science teachers (PSSTs)**

The significance and importance of collaborative effort were overwhelmingly acknowledged by the PSST participants. The U-CE project aided the PSSTs to investigate and do group work independently of the lecturer. This necessitated the need for collective efforts to achieve the set goals. The social and intellectual rewards and experience of working together of the PSST participants are evident in the following extracts:

We divided ourselves into groups for watering and checking the garden according to our free periods. (PoE2)

We must learn to work collaboratively as a group and, we must learn from our own knowledge, the new strategies on how to plant… (FG1 PSST3)

Working together to accomplish a shared goal… At first, we were dragging our feet because we did not know how to start this project. However, as we moved along sharing ideas, I was enlightened, and I believed that we can pull this off! (RJ PSST3)

Finding a suitable time to meet as a group, whereas everyone had classes at different venues at different times, was challenging. We drew a schedule as to who will water the garden at a certain time and date. (RJ PSST5)

We were getting water from our school (campus), I've got reminders too, every time if they see me, they reminded me; my friends, if they see me, they reminded me. WhatsApp would remind me every time, every day. (This participant had forgotten to water the garden on several occasions: a challenge for her but received support from peers). (FG2 PSST1)

Pre-service science teachers who participated in this study synergized their effort through time management strategies. The PSST participants felt the need to put a variety of views together to achieve a successful U-CE project. The PSSTs worked on their timetables to ensure that they could meet and take important decisions coupled with doing routine activities such as watering of the food garden. Significantly, the collaborative effort employed the use of technological devices such as smartphones where the application called 'WhatsApp' was utilized to ensure quick communication and reminders to group members about garden tasks that were due. 'WhatsApp' is a communication app in a smartphone that allows users to text messages, chat, share voice and video messages with individuals and groups when the device is connected to the internet (Montag et al., 2015). The use of digital communication devices and interaction by the PSSTs who participated in the study resonates with the works of Falk (2012), Pickering, Bast Jr, and Keyomarsi (2015) and Espey (2018) who asserted that communication is essential to teamwork success. Additionally, through collaborative efforts, a group can make a more desirable determination as compared to an individual's perspective because there is the deliberation of a variety of viewpoints (Bialik, Fadel, Trilling, Nilsson, & Groff, 2015).

For knowledge to be actively constructed by students, Tuckman and Monetti (2011) argued that working together and learning from one another, by the students, leads to the acquisition of knowledge instead of just being told what to do by the instructor. It is essential for pre-service teachers to have teamwork competencies as these will enhance healthy professional interactions with their contemporaries, learners, and parents when they become in-service teachers in the future (Ammentorp & Madden, 2018). The Ontario Ministry of Training Colleges and Universities (2009, para. 1) asserted that teamwork is one of the "essential employability skills" that graduates of postsecondary education should have. The Ontario education body expressed that any graduate leaving the higher education institution should be able to (i) "show respect for the diverse opinions, values, belief systems, and contributions of others", (ii) "interact with others in groups or teams in ways that contribute to effective working relationships and the achievement of goals". In view of the foregoing, the PSSTs who participated in this U-CE research demonstrated teamwork which is one of the employability skills vital for successful workplace life.

The following excerpt from the portfolio, developed by group four, provides more insight into PSSTs' collaboration in this study.

Schedule of events

10 March 2017, Thursday

We met and contributed R20 for buying seeds and had a little discussion on when we were going to meet for the of starting our garden.

11 March 2017, Saturday

We removed the grasses and made beds. We also added fertilizer (compost) on our soil and then we watered it for it to be mixed properly and to be soft.

13 March 2017, Monday

We did measurements and spacing. On the planting process, we decided to plant the same crops on one bed to avoid competition among crops. Lastly, we watered them.

14 March 2017, Tuesday

We met and drafted the watering timetable. It is as follows

DAYS	*NAMES*
Monday	*S M, SM, and AM.*
Tuesday	*PZ and SN.*
Wednesday	*SM, SK, and PZ.*
Thursday	*SM, SK, and AM.*
Friday	*LM, AN, and SN*

06 April 2017

We met at the garden to check how it was progressing and we removed the weeds that were starting to grow around the seedlings, as we were going away for the Easter holidays. From the day, we came back from the holidays we continued to water the garden as we had been doing previously.

05 May 2017

We decided to meet where the garden is situated, and we removed the weeds and watered the plant. And agreed to meet on a Saturday to talk and prepare for the oral presentation that was going to take place the following Monday and we divided the work for the garden portfolio.

(PoE4)

Moreover, the following sets of photographs emerged from the portfolio of evidence; developed by PSSTs, in group two and six respectively, which reinforced the collaborative effort of the biology students during the study:

(PoE2)

(PoE6)

The excerpt from PoE2 (displayed as a schedule of events) was evidence of planning and organization on the part of the PSSTs while working as a team. The PSST participants captured how their activities were scheduled as well as the allocation of some duties in the portfolio of evidence. Also, PoE2 and PoE6 included pictographic

scenes where the demonstration of working together on the food garden was evident. The pictures in PoE2 and PoE6 reflected the teamwork that the PSST participants experienced during the U-CE program.

The contribution of each member of a team can bring about teamwork results that are valuable to all the members of the team (Guchait, Lei, & Tews, 2016; Volkov & Volkov, 2015; Woodcock, 2017). Students' learning faculties are enhanced through collaborative effort during community engagement activities (Bandy, 2016; Bednarz et al., 2008). The success of community development that is managed by the involvement of the community members relies on their local expertise and their labour force (Fonchingong & Fonjong, 2003). Hence, the working together of PSSTs who participated in the U-CE project created instructive interactions and cohesion among the peers who were outside the normal classroom environment.

Theme 3:

- **Self-directed research based on the nutritional and health needs of students**

The implementation of U-CE using the food garden project involved carrying out some self-directed research about the nutritional and health needs to manage health challenges and hunger of the students on campus by the PSSTs. The following excerpts from the portfolios of evidence and individual interviews confirm this:

We conducted a survey here at the campus and discovered some students who wear glasses are also affected by night blindness. A person who suffers from night blindness has a deficiency of vitamin A. Vitamin A helps in the development of healthy skin and nerve tissue, functions in the eyesight and bone formation. (PoE1)

…talking about carrots, they are very important… hmm because they contain nutrients such as vitamin A. Hmm… Vitamin A has an important role in vision because it helps the photoreceptors in the eyes to work more efficiently. This nutrient enables opsin proteins to form in the cone cells to process light in daytime conditions and rhodopsin proteins which are the proteins that are also found in the eyes in order to form in the rod cells in order to process light in dim conditions. If there is a deficiency in Vitamin A, this can lead to vision problems eventually blindness. When a person

does not consume Vitamin A, over time, the photoreceptors in the eyes begin to deteriorate; disrupting vision. (II PSST6)

We chose mustard spinach as it helps to lower high blood pressure. Spinach is low in fat and even lower in cholesterol which is good for students as they normally eat or buy food with high cholesterol. (PoE2)

…we even discovered through our research that some food that we eat… can err ...can cure certain diseases, not cure but manage and control them, like beetroot for people who… who lack iron beetroot is very good for them… sometimes we just eat it for fun or for taste, but we learnt that they do make a difference… (FG3 PSST1)

Table 9: Summary of some disease conditions researched by PSSTs and the health benefits to the student community

Group	**Disease condition researched upon**	**Type of crops planted**	**Nutrients**	**Functions**
PoE1	Night blindness	Carrots	Zinc	Zinc helps vitamin A create the pigment melanin, which protects the eyes
	Cardiovascular disease and cancer	Spinach	Vitamins A, E	Reduces age related-muscular regeneration and protects body tissues from free radicals
	Night blindness	*Amadumbe*	Major source of Vitamins A and C	Vitamin A improves the eyes vision while Vitamin C strengthens the bones of the body

PoE2	Night Blindness	Carrot	Vitamins A, C, K B8, Potassium, iron, copper and manganese	The nutrients in the carrots help the retina to improve vision
	High blood pressure	Spinach	Low fat, low in cholesterol, Vitamins A, C, E, K, iron, and magnesium	The nutrients in Spinach helps to lower high blood pressure
	Anaemia	Beetroot	Iron, Vitamin C, fibre and potassium	The iron helps in the formation of haemoglobin which enhances the transport of oxygen in the blood.

The preceding Table 9 highlighted some disease conditions that were identified through self-directed research by the PSSTs that could affect the student community that resided on the campus (these disease conditions were identified using simple surveys). The survey, group interactions and the self-directed research of the PSSTs informed the type of garden crops that were selected and cultivated for the U-CE project. There was a key step to enable participants to engage in U-CE

The following extract from the portfolio of evidence, compiled by group one, is useful to describe biology PSSTs' rationale for selecting specific plants for the garden project.

Type of vegetation	***Nutrients***	***Function***
Spinach	A. Vitamin A B. Vitamin E C. Zeaxanthin and lutein	*1) Slows the progression of macular degeneration which causes night blindness, promotes good vision.* *2) Protects body tissue from damage by free radicals.*

		*3) Prevention of age-related macular degeneration*
Carrots 	a. Rich in vitamin A (beta-carotene) b. Vitamin E c. Zinc	*1) Beta carotene and other antioxidants help improve vision and keep eyes healthy.* *2) Vitamin E may help reduce the worsening of age-related macular degeneration (AMD) among people who show early signs of eye disease.* *3) Zinc helps vitamin a create pigment melanin, which protects your eyes. Zinc may also help you see better at night.*
Amadumbe (cocoyam) 	*A major source of vitamin A and C*	***1)*** *Beta carotene and other antioxidants from amadumbe (converted by the body to Vitamin A) help improve vision and keep the eyes healthy.* *2) Vitamin C helps to keep the cartilage, bones, and teeth in good condition.*

(PoE1)

Spinach contains proteins, vitamins A, C, E and K, iron and magnesium which help lower blood pressure. Vitamin A is a powerful antioxidant. Plays a role in

maintaining healthy vision, neurological functions, healthy skin and more which students can benefit from. Vitamin C is known as ascorbic acid, is necessary for the development and repair of all body tissues. Involved in the formation of collagen, absorption of iron, wound healing, and maintenance of cartilage, bones, and teeth. (PoE2)

Nutrition / Diet (/categories/nutrition-diet)

(/)

Spinach: Health Benefits, Uses, Precautions

Written by Megan Ware RDN LD (/authors/megan-ware-rdn-ld)

Knowledge center (/knowledge-center)

Last updated: Sun 13 September 2015

2926 SHARE 4

Popeye was definitely on to something. Spinach is a super food loaded with tons of nutrients in a low calorie package.

Dark leafy greens like spinach are important for skin and hair, bone health, and provide protein, iron, vitamins (/articles/195878.php) and minerals.

The possible health benefits of consuming spinach include improving blood glucose control in diabetics, lowering the risk of cancer (/info/cancer-oncology/), lowering blood pressure (/articles/270644.php), improving bone health, lowering the risk of developing asthma (/info/asthma/) and more.

This MNT Knowledge Center article is part of a collection of features on the health benefits of popular foods (/articles/269143.php), all written and reviewed by our qualified nutritionist.

Possible health benefits of spinach

Diabetes management: spinach contains an antioxidant (/articles/301506.php) known as alpha-lipoic acid, which has been shown to lower glucose levels, increase insulin (/info/diabetes/whatisinsulin.php) sensitivity and prevent oxidative stress-induced changes in patients with diabetes (/info/diabetes/). Studies on alpha-lipoic acid have also shown decreases in peripheral neuropathy (/articles/147963.php) and/or autonomic neuropathy in diabetics.[1]

Of note, most studies have used intra-venous alpha-lipoic acid and it is unsure whether oral supplementation would elicit the same benefits.[1]

Cancer prevention: Spinach and other green vegetables contain chlorophyll which has shown to be effective at blocking the carcinogenic effects of heterocyclic amines which are generated when grilling foods at a high temperature.[2]

Asthma prevention: The risks for developing asthma are lower in people who consume a high amount of certain nutrients. One of these nutrients is beta-carotene (/articles/252758.php), of which spinach is an excellent source. Apricots, broccoli, cantaloupe, pumpkin (/articles/279610.php) and carrots are also rich sources of beta-carotene.[3]

(PoE3)

The Health Benefits of Carrots

Consuming Carrots are known to be good for the overall health and specially organs like the skin, eyes, digestive system and teeth. Carrot is used in several Juice Therapy Remedies for diseases. Given below are some benefits of this Vegetable.

- Carrots are rich in Beta carotene which is a powerful antioxidant which helps in maintaining a healthy skin and also keep one away from many diseases.
- Carrots are rich in alkaline elements which purify and revitalize the blood.
- They balance the acid alkaline ratio in the body.
- Carrots have Potassium in it which helps to balance the high levels of sodium associated with hypertension and keeps blood pressure under control.
- The high soluble fibre content in carrot, it reduces cholesterol by binding LDL, the bad cholesterol, and also increases the HDL which helps in reducing blood clots and heart diseases.
- Carrots are great for dental health as they kill harmful germs in the mouth and prevent tooth decay.
- Carrots aid digestion by increasing saliva and supplying the minerals, vitamins and enzymes required for it.
- Regular consumption of carrots helps in preventing gastric ulcers and digestive disorders.
- Raw carrots are used as a home remedy for treating worms in children.
- Raw or grated carrots can be used for wounds, cuts and inflammation.
- Carrots are rich in Carotenoids which are beneficial to blood sugar regulation.
- Carrots contain a phyto-nutrient called falcarinol which helps in promoting colon health and a reducing the risk of cancers.
- Consuming carrots regularly are known to improve the quality of breast milk in mothers.
- It also helps in increasing the menstrual flow.
- Consuming Carrots regularly can improve the appearance of skin, hair, nails etc and also improve eyes health.

(PoE3)

Five Health Benefits of Beetroot
By: Sandeep Godiyal, Natural News

Beetroot, also often known as the beet, is a root vegetable that has been consumed since ancient times. Even the ancient Romans and Greeks thought beetroot had vitamins and minerals. In fact, today's studies prove that not only are they loaded with beneficial nutrients, but beetroot is an amazing way to ensure that a person stays healthy.

A root vegetable, the reddish and bulbous portion of the beetroot is grown underground while its leafy top is seen above the ground. It grows in both tropical and temperate areas, and takes about two months to reach maturity. Though the plants have been cultivated for thousands of years due to their dietary benefits, it is only recently that their many health benefits have been explored.

1. Beetroot enhances sex
The ancient Romans prized beetroot as an aphrodisiac and raised them as such. Today's science supports this Roman practice. Researchers have found that beets contain high amounts of boron, an element that relates directly to the production of sex hormones in humans.

2. Beetroot equalizes mental health
Betaine, the same component that is used by practitioners to treat depression using certain methods, is found in beetroot. Another great element that beetroot contains is tryptophan, which has been shown to create a sense of well-being while also relaxing the mind. They are also a great way to lower blood pressure, which can help offset the effects of stress on the body.

3. Beetroot increases energy levels
Because the sugar contained in beetroot is released slowly throughout the body, even though the sugar levels are high, they help maintain steady energy levels. When compared to foods such as chocolate whose sugars are processed quickly by the body, beetroot, which is also low in calories, makes its energy boost last a great deal longer.

4. Beetroot is high in vitamins and minerals
Because they are high in vitamin B and iron, beetroot is especially beneficial to those women who are pregnant. Vitamin B and iron are necessary for the growth of new cells as well as replenishing the iron levels that often dip at this time of life. In addition, beetroot is high in the following vitamins and minerals: fiber, phosphorus, potassium, folic acid, beta-carotene, vitamin A, magnesium, vitamin C and betacyanin.

(PoE3)

According to the preceding extracts, PSST participants demonstrated some of the skills necessary for carrying out academic research. A survey was conducted by the PSSTs and information was gathered on the nutritional and health needs of students who resided in the university campus residence. The outcome of these investigations informed the choices of food garden crops that the PSST participants cultivated. Through discussion and collaboration, they selected crops that, through a literature study, they believed could mitigate some of the nutritional and health challenges experienced by the students residing on the university campus residence. The self-directed research undertaken by PSSTs is crucial to attaining a Bachelor of Education (BEd) degree in South Africa as stipulated by the Government Gazette document of

the Department of Higher Education and Training in South Africa (Department of Higher Education and Training, 2015). The Government Gazette emphasizes that it is a prerequisite for pre-service teachers qualifying for the BEd degree in South Africa to develop academic autonomy and research capacity, at a preparatory stage, in order to be groomed for postgraduate studies as well as for professional readiness as future teachers. Prince (2019, p. 1) alluded to the following:

> "Teachers use their autonomous space as curriculum makers to achieve different practices and their 'personality of change' accommodates this non-mandatory curriculum area. These strategies are relevant to beginning teachers and in international settings, to identify how teachers might respond to change and deconstruct their practice".

Thus, the significance of exposing PSSTs to self-directed learning situations during their training cannot be overemphasised because the professional identity that culminates in pedagogical competence is enabled (Gencel & Saracaloglu, 2018; van Wyk, 2017). In my study, pre-service teachers connected health challenges experienced by other students (real-world situations), to minerals and vitamins which could be sourced from specific crops (which they learned through desktop research), which they cultivated (outdoor project).

Holland (2005) bemoaned the fact that institutions of higher learning approach community engagement programs from the perspective of their teaching and learning process rather than considering a wider outlook of engaging with the partnering communities, which amounts to self-serving. One of the essential criteria in community engagement activities is the identification of the idiosyncratic needs of the community under focus (Fitzgerald et al., 2016; Rhodes University, 2016; University of South Africa, 2013). In addition, Bruce-Davis, Gilson, and Matthews (2017) confirmed that by integrating social equity and identifying communal issues, students can transform society through interaction with the community. It follows that the self-directed research embarked upon by the PSST participants in my study (by identifying idiosyncratic needs of part of the university student community) resonated with these assertions of the academic scholars and the higher education institutions. Thus, the PSST participants embarked on self-directed research to identify the nutritional and

health requirements of the PSTs' community on campus to be guided on the selection of the appropriate garden crops.

Theme 4:

- **Use of problem-solving skills**

Pre-service science teacher participants developed problem-solving skills while engaging in U-CE. Some challenges were encountered while implementing the food garden project. The following data which was generated from focus group interviews and portfolios of evidence alludes to the development of problem-solving skills.

For pest control around the site, we used a net, we also did companion planting which also helped to control the pests. (PoE1)

And then the insects were the challenge but later we developed our strategies like using garlic and spraying it …because garlic is unfriendly (garlic aroma repels pests) *to the insects but is friendly to the environment; another strategy we used to control the pests.* (FG5 PSST2)

The use of garlic (as an insect repellent) to control the pests that affected the food garden crops during the U-CE project was a creative, environmentally friendly way of solving a challenge of the invasion of pests. The PSSTs devised the strategy of using garlic and companion planting as a way of saving the food crops from being devoured by the pests. The value of problem-solving capabilities has been highlighted by scholars and Higher Education regulating bodies. Individuals require the ability to unravel challenging situations through recognizing the problem, finding and choosing the most accessible ways to resolve the matters and finally justifying their perspectives (Flynn, 2017).

"The National Curriculum Statement Grades R-12 aims to produce learners that are able to demonstrate an understanding of the world as a set of related systems by recognizing that problem-solving contexts do not exist in isolation" (Department of Basic Education, 2011, p. 5). The Department of Basic Education document for Life Sciences, Curriculum and Assessment Policy Statements (CAPS), cited in the preceding paragraph, underscores the fact that if Life Sciences teachers are to teach about identifying and solving problems, they need to develop problem-solving skills

themselves. Therefore, I contend that in order for PSSTs who participated in U-CE to be competent in becoming practicing teachers in the future, they must possess problem-solving skills to support the development of learners who will be able to engage with problems needing solutions within the context of the South African socio-economic setting.

4.3 Research Question Two: What are pre-service science teachers' views about requirements for effective university-community engagement through a biology module?

It emerged from the data that students associated the requirements for U-CE with two broad classifications namely: student-driven initiatives and university-driven initiatives.

The following themes emanated from the student-driven initiatives from the data set of this study:

Theme 1:

- **Student-driven Initiatives**

The PSTs who participated in this study suggested that U-CE can be impactful if more students got involved in the project and the project was not once-off or seasonal. Two sub-themes emerged from the data regarding student-driven initiatives.

Theme 1.1:

- **Involvement of more students from the university community in the project**

The participation of more PSTs, who may not be studying biology, was identified as being important by many of the PST participants in my study. This student-driven initiative was alluded to by the following excerpts from the reflective journals and focus group interview transcripts:

It could be hmm… maybe more like a module like for not restricted to biology students only but because some students might not be biology students, but they would like to involve themselves in things like this project. (II PSST6)

All students need to see this as a good initiative and not just leave it to the biology students. (RJ NBPST4)

Once the students (more students) *get involved, the garden project will succeed… which will raise awareness about the importance of starting gardens on campus and at their homes.* (RJ PSST2)

Well, I think if there can be more … students I mean, involved in this project to maybe start a farm or something because there is land down there where we started our gardens so when… many students can be involved…there can be a big garden where they can plant and then this project could be much more progressive. (FG1 PSST3)

Food gardening has become multidisciplinary and initiated by students in some universities across South Africa. A case in point is the University of Witwatersrand where a student organization has taken the initiative to bring students together to cultivate and produce a variety of food crops to help alleviate the suffering of students who are underprivileged and facing hunger in their institution (University of The Witwatersrand, 2018). I infer that the student organization's ingenuity to recognize the food insecurity and other food challenges among the students at the University of The Witwatersrand demonstrates U-CE which resonates, in a small measure, with this study.

Theme 1.2:

- **Sustainability of the project**

Several PSTs who participated in this research were of the view that the garden project should be continued throughout the year, having experienced the value it can add to the well-being of students studying at the university. The extracts below validate the assertion that non-stop gardening all year round, driven by students, was suggested, to bring about positive change to the welfare of PSTs.

Mmm… I think students should do this continuously, they shouldn't stop. They shouldn't just do it because of the marks or the assessment, but there should be a plan or exercise, from what… where we started from till the six weeks we have learnt,

and we have gained experience to do more, so it should be a continuous experience for all of us. (FG4 PSST1)

Maybe throughout the year, it can go throughout the year and even the following year the other students that are planting in the following year they can continue with the gardens. (II NBPST1)

This project should continue until it positively affects students on and off campus. (RJ NBPST6)

The preceding data reveals that many of the PSTs who engaged in the U-CE agreed that the project should be done throughout the year. Some scholars have argued that university gardens be pioneered by undergraduates and supervised by university management. Similarly, Duram and Klein (2015) found that university food garden production, with students' involvement and university support, sustains higher education institutions academically and operationally. The authors concede that food gardens offer avenues for academic research, production of healthy indigenous food and a site for eco-friendly activities. Moreover, the food garden enabled communities' cooperation with the university because food is a universal nutritious substance that everyone consumes.

The following themes originated from the university-driven initiatives from the data

Theme 2:

- **University-driven Initiatives**

The PSTs alluded to the view that the university should play a key role in driving U-CE in addition to students' initiatives, as discussed earlier, for the effective implementation of the activities. Three sub-themes emerged from the data which elucidated how the higher institution can get involved. They are as follows:

Theme 2.1:

- **University management to motivate a greater number of students to engage in food gardening**

Pre-service teachers who participated in this study noted that the university can achieve greater results in the project if more students registered in the university can be co-opted into the project. Excerpts from the focus group interviews and the reflective journals below confirm this position.

This lies in the power of the university; it's their own duty to encourage students; all students, not only biology students to do gardens. (FG2 PSST3)

The institution should recommend this project to all interested students and not only for biology students doing BIO 310 module. (RJ PST9)

…not only providing tools (referring to the university management not merely providing garden implements) *for the educational programs but involving all students, not biology only but everyone should be involved in this gardening project.* (FG4 PSST4)

Scholars have identified one of the shortcomings of community engagement as the inadequate collaboration between the university management and the community-based participants. Dempsey (2010) stressed that there must be a deliberate partnership between university management and the participants involved in community engagement to reduce power disparities and misunderstandings. The experience of most of PSTs who participated in my study corroborated the assertion of Dempsey (2010). It is the responsibility of higher education institutions to create platforms, through community engagement for students to generate knowledgeable opinions and collaborate with one another towards transforming the society (Albertyn & Daniels, 2009). To produce more citizen-scholars from South African universities, Maistry and Thakrar (2012) speculated that a community engagement module can be introduced across all faculties. However, the decision about whether to prescribe to credit-bearing hours will depend on further study. In this study, the students in the university community are the citizens who require the benefits of U-CE. This study disrupts the notion of the community being external to the university. However, insights

from previous research which conceptualize community as lying outside of the university can be applied to the student community within the university.

In the same way, data from the reflective journals (below) alluded to the involvement of more students in U-CE by the university management. The initiative of U-CE, according to the participants, will lessen the lack of financial resources and provide nutritional support to students residing in the residence to live better.

I can be happy if the university includes this kind of project in the modules that everyone can participate in to fight poverty and develop skills. (RJ PSST6)

… Even the university at large can adopt the project for students residing on residences for them to grow their own crops. (RJ NBPST3)

The importance of the challenges encountered during daily life experience has been identified as crucial in transforming students' challenging circumstances. Freire (2000, p. 36) posed the following question: "Why not establish an intimate connection between knowledge considered to any basic curriculum and knowledge that is the fruit of the lived experience of these students as individuals?" The preceding question articulated with the assertions by the students who realized that integrating U-CE activity, such as the food garden project, into the PST curriculum will alleviate food insecurity which was the lived experience (to which Freire had alluded), of some students who resided on the university campus.

Theme 2.2:

- **Provision of more land to expand the food garden project by the university**

The PST participants in this study concurred that the university should provide more land for the expansion of the garden project as an activity for the U-CE. The PST participants believed that the scale at which the PSSTs implemented the project was small and suggested that the U-CE program should be enhanced. One way to do this was the allocation of more land for cultivating food gardens, which would yield a greater harvest which can assuage some of the food challenges of underprivileged

students in the university. Some participants suggested that selling extra harvests could generate income for the PSTs. The following extracts allude to this:

I think the University must provide land for those children (referring to non-Bio students from disadvantaged backgrounds) *to do gardening.* (FG2 PSST2)

Oh… another thing they should… they should also provide err, a certain large plot of land for us, to plant. We should know that this place is for gardening only not other activities. (FG4 PSST4)

Must give them the land if they want to plant so that they (students residing on campus) can sell it to make a profit. (FG2 PSST3)

I mean the university must do some contribution to making sure that this garden is wide (expanded), like a bigger space… so that there can much better products from their gardens because … a lot of students are struggling in the campus. (FG1 NBPST1)

…even here at the university level, if the University can provide our students with enough space to practice our garden it really will be benefiting to the university. (FG2 NBPST1)

The provision of land, as a resource, for implementing the food garden project during U-CE resonated among the PSTs who participated in this study. The PST participants saw ample land as a vital requirement. This reminds one of the Higher Education Quality Committee (2006) criterion 18 which maintained that community engagement must be well resourced to be effectively delivered. In my study, the need for more land as a resource for gardening to benefit the student community was emphasized. The North West University (2016), in its Community Engagement Policy document, asserts that there should be adequate means available for community engagement programs in addition to the research, teaching and learning activities provided by the university for students.

However, not all universities are situated in areas with large arable land. According to Specht et al. (2014, p. 34), “Large-scale urban food production could provide new landscape opportunities and take the pressure off agricultural land. Consequently,

researchers and practitioners aim to find solutions to decouple arable land from production and produce food on a larger scale in and on buildings in high-density urban areas".

The use of sacks filled with soil and compost for cultivating vegetable gardens (Peprah, Amoah, & Akongbangre, 2014) and old bags with old tyres; both filled with compost and soil (University of Free State, 2018b), have been utilized to establish garden farms where there is a scarcity of land. Vertical gardens, which is the planting of vegetables on trellises, walls or platforms above the ground, can mitigate the challenge of food insecurity, help in the area of the shortage of land due to urbanization and conserve water in places with low rainfall (de Villiers, 2019). To substantiate the importance of vertical gardening, Jain and Janakiram (2016, p. 530) submitted that "vertical gardens help in absorbing the obnoxious gases and volatile compounds produced due to the use of all modern amenities, thus reducing the risk of cancer, stroke, depression, heart, and respiratory ailments". Vertical farms or gardens can grow leafy vegetables, seasoning, food and medicinal plants for human consumption (Ngumbi, 2017). Therefore, it is worth considering the provision of land or improvised planting spaces as one of the requirements for U-CE. Figure 18 and Figure 19 represent pictures of vertical gardens on a fence and on the walls of a building respectively. If the university cannot allocate adequate land for gardening, then possibilities for establishing vertical gardens could be a worthwhile alternative.

Figure 18: Hydroponic vertical farming system
(Ngumbi, 2017)

Figure 19: Greenwall Vertical gardens World hunger
(Tabachnik, 2015 para. 3)

The preceding photographs (Figures 18 and 19) demonstrated alternative ways of planting garden crops that could be environmentally friendly and alleviate the nutritional and health challenges of communities in the university campuses with limited space of land. Figure 18 displays a variety of vegetable plants cultivated on a fence with recycled plastic materials used for the bases that held the nutrients for the plants and their roots. Tabachnik (2015) speculated that for the world to feed its population by 2050, more than 50% of food produced in 2015 will be required. The author asserted that vertical gardens, like the one shown in Figure 19, will add to an increase in food production.

Theme 2.3:

- **Provision of more tools for food gardening by the university**

In addition to the university-driven initiatives agreed to by the participants in this study, the provision of adequate, accessible garden implements by the university was important. The PSST participants encountered the problem of a lack of tools while engaging in the U-CE project. The following excerpts from the reflective journals pointed out the need for the university to provide more tools for U-CE.

The provision of enough working materials could make this project a success in the future. (RJ NBPST2)

The provision of more garden equipment for the garden project was further exemplified in the focus group interviews and the individual interviews as indicated below:

I think we should have the necessary tools available because we are very short of …tools that we need to do our plan…mmm, our garden like the err… they should allow us to get the equipment at any time… (FG3 PSST1)

…gardening materials like hoes because we used to use one hoe or spade and fork and stuff (they were sharing). They (lecturers) *can provide us with many hoes, forks, spades ….* (II PSST5)

According to FG3 PSST1, the availability of tools and equipment for cultivating and maintaining the gardens was crucial to the success of the garden project. The participants did not receive tools on time due to certain logistic reasons and they also had to share equipment which, the participants indicated, slowed down the pace of their work. Participants mentioned a lack of implements was initiated by the researcher who asked them to describe the challenges associated with establishing food gardens. It was not as a result of demotivation on the part of the participants. However, the PSSTs believed that with more tools, the program could be more successful in the future.

Scholars have concurred that community engagement provides meaningful learning experiences for students in Higher Education institutions (Clements & Bohannon, 2015; Karwat et al., 2013; Krause & Croates, 2008). “To make learning engagement meaningful we should prepare, support and empower students with strategies to build on positive engagement experiences” (Krause, 2005, p.12). The support, I argue, should include the provision of material resources, such as tools and equipment that PSTs can use for food gardening projects during the U-CE.

4.4 Research Question Three: What are pre-service science teachers’ views about how university-community engagement can influence the well-being of students at a university?

Pre-service science teachers who participated in this study believed that some of the food garden crops planted could improve the well-being of students residing in the university community. The well-being referred to by the PSSTs included health

benefits, diet and socio-economic status of underprivileged PSTs. Five themes emerged from the data which are discussed below:

Theme 1:

- **Promotion of good health and diet**

According to the PSST participants who engaged in this research, food gardens could promote good health and diet. The embarking on the self-directed research and the outcome of the garden project, in terms of harvest, had enlightened and raised participants' consciousness about the importance of healthy food. Extracts below from the focus group interviews and research journals attest to the claim that the exercise (cultivating food gardens) could influence good health.

…we even learnt that some food that we eat… can err ...can cure certain diseases, not cure but manage and control them, like beetroot for people who… who lack iron; beetroot is very good for them… sometimes we just eat it for fun or for taste, but we learnt that they do make a difference… (FG3 PSST1)

We planted carrots which are good for our eyes (from research), beetroot which is good for our blood and spinach as well which is low in cholesterol also good for our blood and contains iron as well. (RJ PSST6)

Ordinarily, the topic 'Nutrition', in the EDBS 310 biology module studied by the students in this research could have been approached by solely using a physiological and anatomical lens, without applying it to social aspects, the latter which involves lived experiences of the students. However, through U-CE, the PSSTs (FG3 PSST1 and RJ PSST6) went a step further to learn that beetroot, which is rich in the mineral iron, could alleviate the condition of anaemia, by restoring haemoglobin in the blood which ultimately improves the well-being of students residing in the residence. This marked the integration of "pure" science with the social reality of students. This resonated with Freire (2000, p. 36) recommendation to "establish an intimate connection between knowledge which students construct through the curriculum and their lived experience".

The views of the PSSTs who participated in this study about the medicinal properties of plants, for example, beetroot, are corroborated by other scholars. Cooked beetroot

and vegetable juice made from beetroot are highly abundant in iron and essential for treating anaemia in children, adolescents and adults (Gitau et al., 2016; Santoyo-Sánchez, Aponte-Castillo, Parra-Pena, & Ramos-Penafiel, 2015; Soundarya & Suganthi, 2017). Additionally, the lack of adequate haemoglobin in the blood of human beings could result in severe fatigue, poor well-being and reduced cognitive ability (Patil & Navghare, 2019). This has implications for students, whose well-being and good cognitive health is vital to their academic success.

It is worthy of note that PSSTs identified, through research, that madumbe*, (*singular for amadumbe, a crop commonly known as cocoyam*)* an indigenous crop, could boost the immune system of the students who reside on the university campus. This position was confirmed by the extracts below from the reflective journal and the portfolio of evidence (PoE).

We planted amadumbe (Colocasia esculenta) which consists of large amounts of vitamins A and C plus other phenolic antioxidants help boost the immune system and remove dangerous free radicals that roam about in our bodies. Its high level of dietary fibre allows the food to progress (move) *efficiently* (in our bodies)*.* (RJ PSST10)

Beta carotene and other antioxidants from amadumbe (converted by the body to Vitamin A) help improve vision and keep the eyes healthy. (PoE1)

The significance of antioxidants in healthy living of the students who reside in the university campus, as described above by the PSSTs who participated in this research, revealed their raised consciousness about student well-being. In a study carried out in South Africa by Chukwuma, Islam, and Amonsou (2018, p. 10), it was revealed that “amadumbe mucilage extract showed more potent antioxidant activity as compared to okra mucilage and this can ameliorate oxidative stress” in human beings. According to Atawodi (2005), the presence of free radicals in the human body is suspected to be responsible for some neurological and other illnesses. The author warns that the reduction in the number of antioxidants available in the human body to counter free radicals can result in oxidative stress which could lead to diabetes. Ndhlala, Ncube, Abdelgadir, Du Plooy, and Van Staden (2017) argued that many African traditional medicinal plants, which have been subjected to drug tests to assess their potency scientifically, have great potential of antioxidants in them.

Furthermore, Mudaly (2018) stressed that marginalized indigenous knowledge and medicinal plants should be brought from the periphery to the centre in the curriculum for pre-service teachers. The scholar argued that highlighting the value of indigenous knowledge and medicinal plants in the biology modules and curriculum of pre-service teachers is a form of decolonization. In line with decolonisation of the curriculum, where issues that are sociocultural and indigenous are added to the mainstream curriculum, Le Grange (2016, p. 7) asserted that the "null curriculum", which represents "what universities leave out – what is not taught and learned in a university" should be given serious consideration when training students in the university. The need to make the curriculum of universities in South Africa more 'Afrocentric' than 'Eurocentric' was added to the debate of decolonising the curriculum by Fataar (2018). In my study, students conducted a literature search about the value of indigenous crops, such as *amadumbe*, and found that these plants contained health-promoting nutrients and applied this knowledge to the garden project. Their valuing of indigenous plants marked disruption of the mainstream curriculum, which marginalises indigenous knowledge.

From the foregoing, it can be deduced that PSSTs integrated their knowledge of science with the needs of the students, who reside in the university community, and the selection of plants for this project. In addition, many of the PSSTs emphasized the disadvantages of eating nutrient-poor (junk) food which has negative effects on people's health. The excerpt below attests to this view:

> *It's gonna help them* (the residence students) *because of these… vegetables and crops that we plant in our… have different nutrients, unlike the food that they* (students) *buy at the Melz* (student cafeteria) *… because eh… like the fried chips are not healthy so the carrots and the beetroot are healthy food; they've got some nutrients that are needed by our bodies.* (FG2 PSST4)

More so, PSST4's viewpoint in the preceding excerpt indicated that the student knew the undesirable effects of eating unhealthy food like 'fried chips'. The PSSTs had observed that many other students residing in the university community, relied on eating calorie-rich, nutrient-poor food which could impact health negatively, as compared to eating healthy food such as beetroot. This consciousness-raising could disrupt unhealthy dietary choices through U-CE.

Studies have revealed that community garden produce reduces the incidence of obesity and encourages individuals to eat healthy food (Centers for Disease Control Prevention, 2011; Zick, Smith, Kowaleski-Jones, Uno, & Merrill, 2013). Among young people, time constraints and lack of adequate healthy food in the educational institutions are part of the hindrances to healthy eating (Croll, Neumark-Sztainer, & Story, 2001). These authors conducted a study that revealed that young adults have the knowledge of healthy food but lack healthy eating behaviour as a result of the preceding reasons. Croll et al. (2001) advocated for bridging the gap between having the knowledge of healthy eating and practicing healthy eating behaviour. Based on these insights, I contend that a food garden program, located within a biology module which includes Nutrition as a topic, under the umbrella of U-CE, can provide such an intervention, where scientific information about healthy food is reinforced by producing the food for PSTs residing on the university campus, by PSTs.

Theme 2:

- **Food security amongst the PSTs**

The benefit of having a regular supply of food at one's disposal was alluded to by the PSST participants. The participants reiterated the advantages of having a regular food supply vis-á-vis the challenges of hunger that some students experience on campus due to poverty. The following excerpts from the data reveal the food insecurity suffered by students:

…there is a period which is called err…we normally call it a hunger week… it's when everyone or every student is struggling in terms of food, so before the meal allowances (feeding allowances for funded students)*; it's like it's over. So, in terms of the hunger week …it can; the garden can sustain that week and there will be no more hunger week. (FG1 NBPST3)*

The above extract emerged from one of the focus group interviews of the NBPSTs who were involved in this study. The participant voiced the nutritional stress that students from disadvantaged backgrounds suffer while studying and living in the university campus community. This highlighted the extent of food insecurity among PSTs on campus, although some students are funded and receive some allowances from the government funding schemes. The non-biology PSTs' experiences of food

insecurity while in an on-campus residence informed the extracts below from PSSTs who participated in this research.

…they (NBPST participants) will acquire food from the garden, so food insecurity strain will be reduced. (RJ PSST9)

…it can do a great positive impact on them (disadvantaged students) *because they can go and harvest at any time when they feel hungry. So that they can get their nutrition and focus on their studies.* (II PSST2)

I also think that they could implement this exercise in their homes and in their communities because some of them are coming from poor background homes. (FG4 PSST4)

Pre-service science teachers combined their knowledge of science with the findings from their self-directed research, about the health and nutritional needs of PSTs who were residing on campus, to offer a solution to the challenge food insecurity among students in the campus community. This repository of science knowledge enabled PSSTs to understand more deeply the 'how' and 'why' of food gardening.

Also, data from the following extract from the portfolio of evidence, below, alluded to the importance of food security amongst PSTs on the campus where the participants in my study undertook their Bachelor of Education training.

Students are facing the problem of having no choice when it comes to nutrition or food they eat because of financial issues; they normally eat junk food as it is cheap. Even though they are facing a challenge of a balanced diet they also don't really know how to plant their own vegetables, which can help them a lot instead of going to the market to buy. Engaging such students in a garden project can help them learn how to plant and look after their vegetables and crops to fight ignorance and starvation. (PoE2)

The above excerpt from the portfolio of evidence (PoE2) further indicated the challenges of food insecurity among the PSTs in the university community and suggests that the food garden could be a suitable response.

Researchers, both locally and internationally, have conceded that university students find it difficult to have a consistent supply of adequate, inexpensive and wholesome food. Thus, food insecurity is a critical concern amongst university students (Davidson & Morrell, 2018; Munro et al., 2013; Nazmi et al., 2018; Van den Berg & Raubenheimer, 2015). Munro et al. (2013) recommend that it is vital to raise the consciousness of the danger of food insecurity in Higher Education institutions to counter the adverse effects on students' educational performance. Therefore, I argue that U-CE through food gardening is one way to conscientize universities towards alleviating the menace of food insecurity in the university community. Aftandilian and Dart (2013, p. 1) contended that "garden-based service-learning approaches work toward food justice, better educate undergraduate students, and strengthen campus-community ties". In this project, the participant saw the potential of using food gardening to "fight ignorance", which is reinforced by the assertion of Aftandilian and Dart (2013) about providing a better education through garden-centred learning.

Theme 3:

- **Self-reliance**

Participants in this study contended that U-CE through food gardening could promote self-reliance among students. Most of the participants discussed how the U-CE project raised their consciousness towards becoming independent and self-sufficient. This opinion is corroborated by the data generated from the individual interviews, research journals and focus group interviews below.

I gave a hand (assisted with the group project) *and helped a lot, so, somehow, it's left within me, I can still do it even alone I can start a garden on my own so, yes, I did a lot of things.* (II PSST5)

The knowledge and skills I gained are that err…like err… you can start something from nothing, and it can be productive, and it can help other people, so what I observed there is that they used to plant their gardens without using the inorganic fertilizers. (FG2 NBPST2)

Yes! I can be self-reliant because now I've gained experiences, I know how to manage, how to do this, how to do that, that's also part of self-reliance. (II PSST1)

They (food gardens) *help us to be independent of government and be able to start our own businesses from scratch and benefit South African communities.* (RJ NBPST2)

Especially that South Africa is facing a big rate…an increasing rate of unemployment …This err… food that we think can help a lot of youth… err… I'd say youth because they are... they have more power…to do the garden which is not very easy in terms of err… soil preparation and stuff. They (disadvantaged students) *will be able to…to have their own income and not depend on … being employed even in…in the fields they can be employed.* (FG3 PSST1)

According to the foregoing excerpts, self-reliance emerged as one of the attributes the PST participants claimed to have achieved through the U-CE. The involvement of the PSTs in U-CE and the experience attained stimulated the mindsets of the PSTs that they could develop the food gardens on their own with little or no help from the government. For this reason, one of the PSSTs, FG3PSST1, asserted that the characteristic of self-reliance, developed through U-CE, could help reduce the unemployment rate in South Africa if PSTs can be self-sustaining and entrepreneurs in food gardens. Statistics South Africa (2018) revealed that the unemployment rate in South Africa stands at 27,1% as in the 4th quarter of 2018. Within this dire lack of employment, self-reliance through food gardening could be crucial.

Self-reliance has been defined by Burkey, 1993, p. 205, as "the expression of the individual's faith in his or her abilities and the foundation in which genuine development can proceed." Marinova and Hossain (2006) asserted that self-reliance allows the community members to believe in their competences and self-esteem rather than depending on handouts from external sponsors. What is more is that self-reliance enables poor individuals in a community to cultivate food gardens on their own and at the same time, sell part of their produce to earn proceeds for buying other food items not grown in their plots (United Nation High Commissioner for Refugees - The UN Refugee Agency, 2005). The UN Refugee Agency (2005) noted that the anguish of humanity experienced as a result of poverty will be reduced if people are self-reliant and not only depending on aid. Subsequently, many PSTs in my study expressed the perspective of being able to carry out the garden project independently in the future.

This revealed that PSSTs developed a boldness about their self-efficacy, as it related to food production.

As can be inferred from the excerpts above, the well-being of a person is not limited to the physical effects of food gardening but can also add psychological benefits which are products of intellectual freedom, non-reliance on the material and intellectual resources of other people. Thus, PSSTs revealed that relying on one's intellectual resources creates independence. This is a key aim of the critical pedagogy which informed this study.

Theme 4:

- **Poverty reduction among PSTs**

Furthermore, pre-service science teacher participants in this research stressed that having competence in food gardening could eventually lead to the alleviation of poverty amongst the students and citizens in South Africa as a whole. The extracts below from the data justified the position held by the PSST participants in this study.

…and can also sell those crops to get money to pay for their credits and…and other things. …credits to print their assignments in the computer LAN. (FG3 PSST2)

Yes, the project is less expensive. It can feed many students who give it all and, in that way, poverty is reduced; students can harvest them anytime they feel hungry. (RJ PSST3)

Yes, because the garden project will be providing food for students and thus reducing poverty and empower students to cope with their studies instead of starving in their residences. (RJ PSST8)

It can reduce poverty and bring about empowerment because when gardening it teaches you so many things when they have harvested their crops, they can eat it and even sell some to make some pocket money. (RJ PSST1)

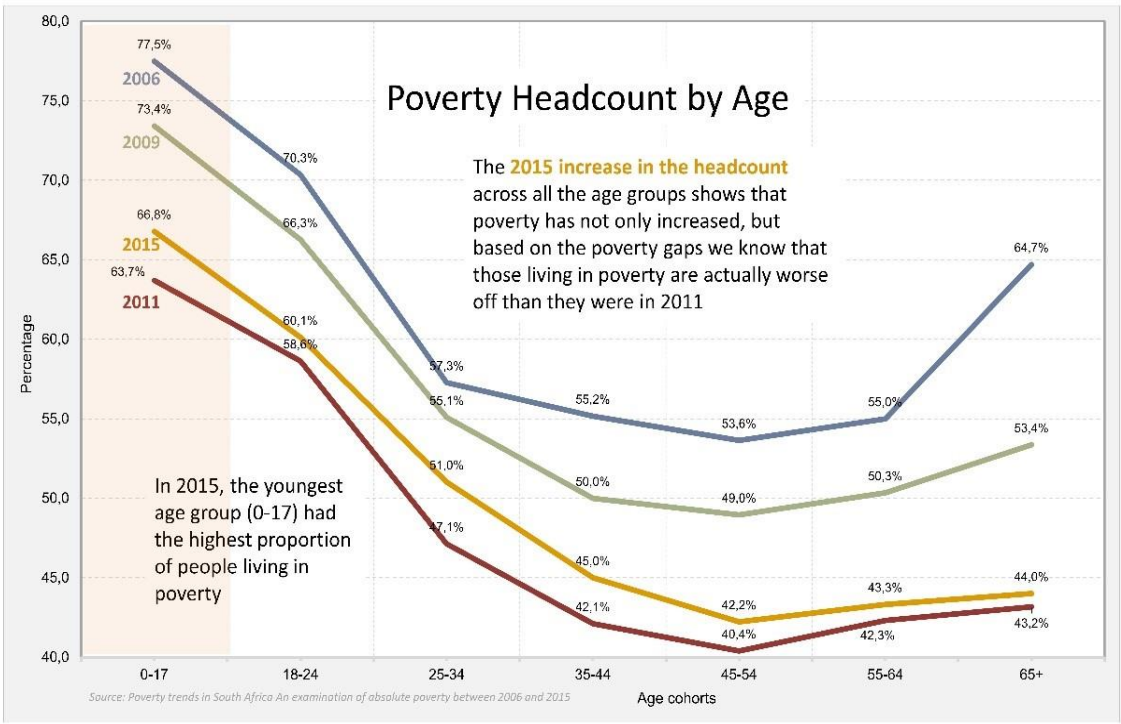
It can bring intellectual freedom from the bondage of poverty since we rely mostly… on the jobs… that you must find a job to feed your family. So, the… this project, the gardens you'll know that from… in order to feed your family, you must go and have your own garden. (FG1 PSST4)

Through reflections and having experienced U-CE, PSSTs believed that the garden project, if expanded within the university and beyond, can alleviate the problem of poverty experienced by many students and citizens of South Africa. This vantage point can be inferred from the transcripts from the reflective journals and focus group interviews (stated above). The PSSTs alluded to the following: a food garden was cheap to cultivate and manage, it can provide a regular source of healthy food to students on campus, it can set students free from intellectual bondage, and the households of students can benefit from the food gardening. According to PSSTs, this could reduce poverty in South Africa in the long term.

Literature suggests that most South Africans, especially those of African descent, are still subjected to poverty, and the students attending universities in the country are not immune to this poverty. The National Planning Commission (2012) stated that South Africa has overcome the era of apartheid, where unjust practices were meted out to the underprivileged Africans, but despite this achievement, many people are still wallowing in poverty, as socio-economic inequality abounds. This viewpoint from the National Planning Commission (2012) is corroborated by Statistics South Africa (2017) which revealed that the number of South Africans living in poverty in 2011 increased from 53,2% to 55,5% in 2015 when the food poverty line grew from R335 to R441. 55,5% represents half of the total population of South Africans as of 2015.

Figure 20 shows that 55,5% of individuals living in South Africa live below the poverty line as of 2015.

Figure 20: Poverty headcount by age and percentages of the South African population
Statistics South Africa (2017)



Furthermore, Table 10 outlines the population of African students registered in the South African Universities between 2008 and 2013.

Table 10: Headcount enrolments in public higher education by race, 2008 to 2013
(Council on Higher Education, 2016a)

	2008	2009	2010	2011	2012	2013	Population 2013
African	515 058	547 686	595 963	640 442	662 123	689 503	42 284 132
Coloured	51 647	55 101	58 219	59 312	58 692	61 034	4 766 172
Indian	52 401	53 629	54 537	54 698	52 298	53 787	1 329 302
White	178 140	179 232	178 346	177 365	172 654	171 927	4 602 388
Total	799 490	837 779	892 943	938 200	953 373	983 698	52 981 991

Consequently, it can be inferred from the data in Table 10 that the number of African students which is 42 284 132 represents 79,8% of the total number of students enrolled in that period. I contend that since most of the population comprises people

of African descent, the students emerging for the families of African homes, who constitute most students at universities, will not be invulnerable to poverty. My study, then, could be important to people who seek to combat poverty through food gardening. Additionally, Bruening et al. (2017) identified that the black population of students and students attending higher institutions in poor geographically developed areas were among the most exposed people to food insecurity. The students, the authors argued have low societal standing or class and more study would be required in scrutinizing the causes, aftermath, and ways of mitigating food insecurity among the group of students.

4.5 Research Question Four: How does engaging in a university-community engagement project influence pre-service science teachers' professional identity for their future practice?

Two themes related to Research Question 4 emerged:

Theme 1:

- **Empowerment**

Feelings of empowerment were overwhelmingly articulated by the PSTs who took part in the study. The following excerpts reveal that PSST participants were empowered.

I do feel empowered as a teacher (future teacher) *because now, I have information on how to start indigenous gardens and if I get a job maybe at a disadvantaged school where disadvantaged learners learn, I can even start a garden there to help them take their crops home and the feed their families if maybe the parents are long gone* (dead) *or they are the only ones who are able to sponsor their families.* (FG1 PSST3)

Also, we could also implement this garden exercise in schools where we are going to teach, for example, some of us are going to teach in deep rural schools, where we must teach learners about plants as from their … background. (FG5 PSST4)

So, it has empowered me as a future Life Sciences teacher. It's not only based on standing in front learners and teach but also involving them in such activities. Yah it was a great experience. (II PSST1)

As a teacher (future teacher)*, the project inspired me to expand it to other schools I will be teaching at.* (RJ PSST10)

Pre-service teachers who participated in the U-CE project felt empowered to do more than what was required of them, as is evidenced by the view of one participant (II PSST1) to go beyond *standing in front of learners and teach.* This marks a shift in the mindset in this participant, from simply teaching from the front of the class to extending the experience of food gardening to the learners she would teach in the future. Moreover, on reflection, participant RJPSST10 echoed the position of II PSST1, by stating that he would go beyond the food gardening in the university campus and extend the idea to the schools he would be working at in the future. It can be summarized from the four data sets under the empowerment theme above that the PSSTs became more passionate about teaching about food gardening in the schools as professional teachers in the future.

Christiansen (1999) asserted that identity is constructed through day-to-day activities over a period and it influences an individual's interaction in society. The author adds that through proficiency in career, identity is moulded which contributes to happiness if the new identity is accepted by the individual. Besides, Mayer (1999) stated that learning the rudiments of teaching such as the methods, content, and curriculum is the first aspect of teaching while developing a teaching identity towards teaching (a second aspect) encompasses having motivational feelings to make a difference in the profession. The author contends that knowing the fundamentals of teaching is termed "being the teacher" while developing an identity over time through perceiving your social environment is "becoming a teacher" (p. 10). Additionally, factors such as individual conviction, prevailing social and environmental influences, family and household backgrounds could impact the identity of pre-service teachers and how they attend to discourses in their teaching career (Gu & Benson, 2015).

Therefore, I submit that most PSSTs who were involved in the U-CE in this research developed the motivation to make a positive difference, not only in the curriculum content knowledge of nutrition (being a teacher) but were inspired to go and make a difference in the lives of their future learners. They were inspired to engage in "becoming a teacher". The empowerment achieved by the PSSTs in this study went beyond only the skills to impart the content specified in the biology syllabus to their

future learners. The PSSTs yearned to bring about social change in the communities where they may find themselves teaching in the future (becoming a teacher).

So, it also empowers us as future Life Sciences teachers to also introduce such in our schools that we are going to. (II PSST1)

Moreover, Lavery, Coffey, and Sandri (2017) alluded to the fact that pre-service teachers attained a significant change in their attitudinal behaviour in addition to their training towards becoming classroom teachers after undergoing a service-learning program that partnered with the community. Scholars have submitted that critical pedagogy emancipates the students who are oppressed and disadvantaged. Freire (1970) described 'self-depreciation' (p. 63) as the conscious belief by the oppressed; conceptualized by the oppressor, that the oppressed are incompetent, indolent and incapable of achieving greatness in life. The author argued that the oppressed can be liberated through thoughtful participation in the act of freedom and not by merely taking them out of the predicament.

Theme 2:

- **Agency through activism**

Most PSST participants enunciated that through U-CE using the garden project, they would become agents of transformation in the South African context. The excerpts below from focus group and individual interviews confirm that the PSSTs believed that through the experience and skills acquired through U-CE, they could be agents of change in the society.

In addition, this will help black people to be independent; blacks always depend on white people or those who are rich, they work for these people if they aren't working for them, they will go and do their garden and sell it. (FG2 PSST4)

As future teachers, I think these garden projects have empowered us to implement or put into action this in schools, whereby it can also help us to fight the epidemic diseases …and fight the big problem in Africa as we are facing; poverty. So, I think this would be big, this would be big … initiative for us as teachers in schools. (FG4 PSST1)

Pre-service science teacher participant – FG4 PSST1 linked food gardening, not only to food insecurity but also by saying that *it can help us to fight the epidemic diseases.* This was very significant because it revealed a sense of agency, an ability to act, on the part of the PSST.

Other participants also confirmed that through the food garden project, they could bring about transformation in the aspect of enhancing well -being and reduction of poverty, as practicing Life Sciences teachers. The data set below attest to this assertion of agency.

> *…this project can also provide a solution to the community, who are highly affected by poverty, as South Africa as a developing country.* (FG1 PSST3)

> *Garden projects can be implemented in schools. As a biology teacher, having the ability and being knowledgeable about gardens, I can positively improve my learners' well-being…* (RJ PSST2)

The data from the reflective journal and individual interview further attest to the awakening of the activism and agency in the PSSTs acquired through participating in the U-CE. de Leon-Carillo (2007) speculated that pre-service teachers begin their training with opinionated notions about the roles of teachers before experiencing the program. However, teachers' identity is reshaped through their development into becoming a teacher; knowing the functions of a teacher and being a teacher (Abulon, 2014; de Leon-Carillo, 2007; Friesen & Besley, 2013).

4.6 Conclusion:

This chapter detailed the presentation and analysis of data generated while exploring the U-CE. Data for this work were obtained from the PSTs who participated in this research through focus group interviews, individual interviews, and reflective journals. In addition, the PSSTs prepared Portfolios of Evidence per group which added rigour to the data.

In providing answers to Research Question One: *How do pre-service science teachers implement university community engagement through their study of a biology module?* four themes were generated. The PSSTs who participated in this study implemented

U-CE by acquiring knowledge of food gardening, collaborating, carrying out self-directed research, using critical and problem-solving skills that would ensure the implementation of U-CE through the study of a biology module using the garden project.

For Research Question Two: *What are pre-service science teachers' views about requirements for effective university-community engagement through a biology module?* Two main themes emerged which were (1) Student-Driven Initiatives and (2) University-Driven Initiatives. With respect to Theme 1, Student-Driven Initiatives, PSTs who engaged in the U-CE activities suggested that the involvement of many students from the university community in the project and the continuity of U-CE throughout the year instead of during 8-12 weeks would make U-CE effective among the community of students studying in the university. Turning to Theme (2), University-Driven Initiatives, PSTs suggested that the involvement of more students, in addition to biology students/PSSTs, in the U-CE, the provision of more land to expand the food gardens, and provision of more tools for the food gardens were required for effective U-CE.

For Research Question Three: *How does university community engagement by pre-service science teachers influence the well-being of students at a university?* Four themes emerged. PSSTs indicated that U-CE through food gardening could promote good health and diet, enhance food security amongst the PSTs on the campus, create self-reliance and reduce poverty amongst the PSTs. The participants believed that the well-being of students could be enhanced through U-CE.

Lastly, in providing answers to Research Question Four: *How does engaging in a university community engagement project influence pre-service science teachers' professional identity for their future practice?* Data revealed that PSSTs engagement in U-CE impacted their identity as teachers in the future. Two themes that emerged were; (1) Empowerment and (2) A Sense of Activism and Agency. The views of the PSSTS prior to engaging in the U-CE about their future as professional teachers were transformed after their participation in the U-CE. The PSSTs felt empowered to create a positive change in their communities through food gardening, and to enhance self-reliance, especially among poor people. This signalled the potential for *becoming* teachers rather than simply *being* teachers in the future.

The next chapter will discuss the analysis of the findings from this study through the lens of the theoretical framework of critical pedagogy.

CHAPTER 5: PRESENTATION OF FINDINGS USING THE THEORETICAL FRAMEWORK – CRITICAL PEDAGOGY

5.1 Introduction

A brief review of critical pedagogy, which is central to this analysis, is necessary in order to underscore its salient elements.

The critical pedagogy theory emanated from the Frankfurt School's critical theory whose main ideas among others were to make humans free from capitalism and the development of self-consciousness in people (Giroux, 1983). The author argued that critical pedagogy would change and emancipate society by not rigidly holding on to its doctrinaire beliefs. Critical pedagogy emerged, like the critical feminist theory, critical race theory, and others, from critical theory to bring about consciousness and motivation in the learning environment for both teachers and learners/students. The view of critical pedagogues is to make students socially responsible and enable them to bring about positive change with a transformation to society.

In my study, the PSSTs studying a biology module (EDBS 310) cultivated food gardens based on self-directed research, which responded to the needs of some students in a university community in KwaZulu-Natal province of South Africa. The project was conducted with the collaboration of PSTs who did not study the biology module but were self-classified as having emerged from socio-economically disadvantaged homes. The PSTs who did not study the biology module resided in the university campus residence, and they observed and worked in the gardens at least twice a week with the PSSTs.

In the preceding chapter four, I analysed the findings from the study using the literature of various scholars and academic institutions. In this chapter, I analyse the findings that emerged from the U-CE study through the lens of critical pedagogy theory, which represented my theoretical framework in this research. The following are among the critical pedagogues who have influenced my thinking: Paulo Freire, Henry A. Giroux, Ira Shor, Rodolfo D. Torres, Peter McLaren, Maxine Greene, Joe L Kincheloe, Maria Nikolakaki and Stanley Aronowitz (Darder, Torres, & Baltodano, 2017).

The analysis in this section draws heavily on Henry Giroux's work on critical pedagogy. Henry Giroux focused on the synthetization of John Dewey's scholastic efforts on progressive elements in education and the Frankfurt school's critical theory (Breuing, 2011).

Dewey (1916, p. 115) argued as follows:

> A society that makes provision for participation for the good of all members on equal terms and which secures flexible readjustment of its institutions through interaction of the different forms of associated life is democratic. Such a society must have a type of education which gives individuals a personal interest in social relationships and control, and the habits of mind which secure social changes without introducing disorder

The preceding quote from John Dewey underscored the importance of an education system that values collaboration, democracy, and flexibility among its stakeholders which can lead to a better society without creating any chaos. Notably is the contribution of Jameson (1974, p. 45) that described "dialectical thinking" as the thinking process in which an individual incorporates opposing thoughts to arrive at a resolution that will make the differing perspectives collaborate. Similarly, "critical thinking in the Frankfurt School's perspective creates a valuable epistemological terrain upon which to develop modes of critique that illuminate the interaction of social and the personal as well as of history and private experience" (Giroux, 1983, p. 35).

Five principles of critical pedagogy were used to analyse the findings of this study. These principles are not exhaustive of all the principles of critical pedagogy but were the most relevant to this study. The five principles are as follows: (5.1) Elevating consciousness, (5.2) Focusing on the marginalized, (5.3) Collaboration and democracy, (5.4) Empowerment, and (5.5) Transformation, emancipation, and identity formation. These five analytical constructs are discussed in the latter part of this chapter.

In addition, the thoughts of other critical pedagogues and critical theorists were also engaged within this analysis.

Figure 21 is the diagrammatic representation of the five principles which was designed by me from the works of Aliakbari and Faraji (2011), Degener (2001) and Giroux (2011).

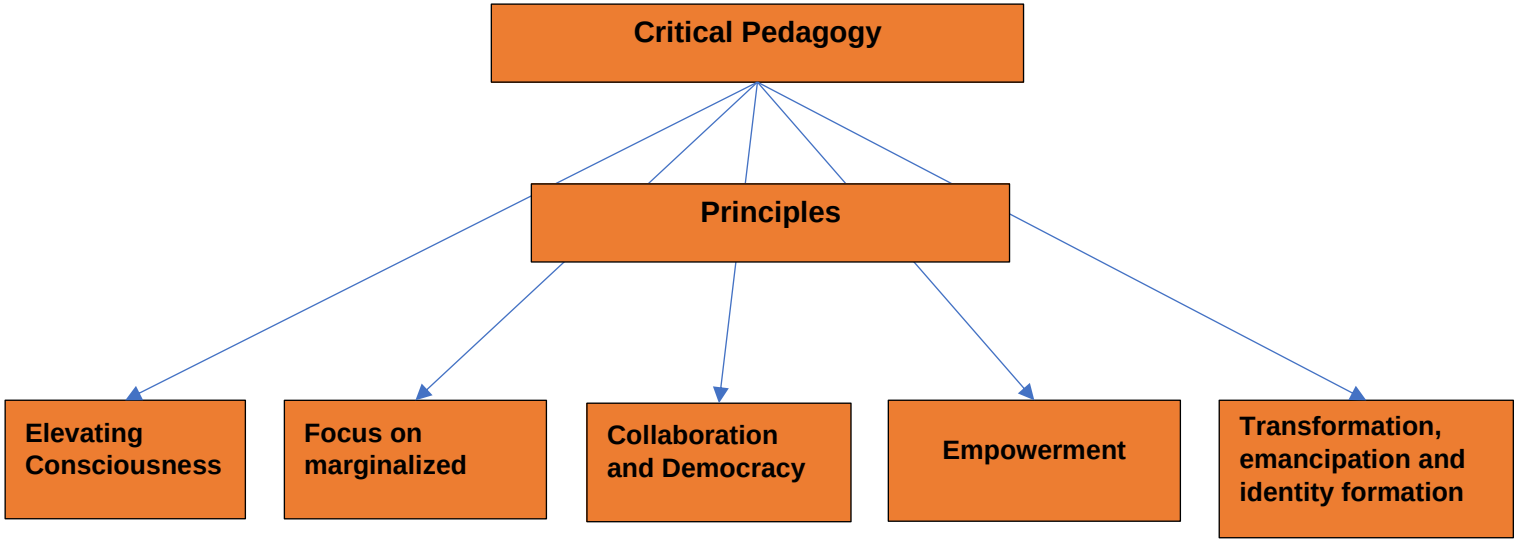


Figure 21: Principles of Critical Pedagogy
Adapted from (Aliakbari & Faraji, 2011; Degener, 2001; Giroux, 2011)

5.2 Elevating Consciousness

The PSST participants who engaged in this U-CE research attested to the fact that they attained new knowledge about food gardening with which they were unfamiliar prior to have embarked on the project. Additionally, indigenous ways of planting food garden crops were learned while cultivating food crops. Consciousness about the role of indigenous knowledge, located in a non-Western paradigm, in food gardening, was raised.

The consciousness and awareness of the PSSTs who engaged in the U-CE project were raised by their involvement in the food garden project. The PSSTs realized that through the new knowledge acquired, they became more informed about food insecurity, food gardening procedures, including methods of planting and management. Giroux (2011) contended that everyone is sensible enough to reason, learn from various sources and utilize the knowledge gained to develop rationally and socially. This view from Giroux (2011) is corroborated by Zygmantas (2009) who concurred that opportunity must be given to students to produce their own knowledge which will enhance their abilities to become more proficient in learning to learn.

Critical pedagogy should be fundamental to the circumstances surrounding indigenous people and the knowledge they contributed to the development of agriculture (Kincheloe, 2008b). "Indigenous knowledge is a rich social resource for any justice-related attempt to bring about social change" (Kincheloe & Semali, 1999, p. 15). In this study, the knowledge of indigenous people was used by PSSTs to design and maintain gardens. The PSSTs who engaged in this project undertook an excursion to an Eco-school. There they learned about permaculture, as well as indigenous plants, their medicinal uses, and methods of planting. An indigenous knowledge (IK) expert, in addition to the permaculture specialists, conducted a series of workshops and demonstrations on the cultivation and benefits of the various types of indigenous fruits and vegetables planted at the Eco-school. The PSSTs were also enabled to plant some food crops using IK methods and permaculture while on the trip as a form of gaining first-hand experience. Freire (1970) maintained that students should not be docile learners but rather energetic individuals with conscious mindsets to challenge the pre-set curriculum imposed upon them by the minority that is privileged. He

believed that society prescribes the content of the syllabus to serve a few people. Also, “Education is not seen as neutral, and it is thought that those educators who want to make a difference in the lives of their nonmainstream students must resist the status quo that privileges mainstream students’ cultural practices, language, and experiences in every aspect of the educational system” (Degener, 2001, p. 55). In this study, through the non-conventional pedagogy, the consciousness of PSSTs was raised regarding the acquisition of new knowledge of food gardening, within a context that illuminated the plight of food-insecure students and students’ health challenges.

Most PSSTs who participated in the U-CE developed some problem-solving skills which they applied when faced with numerous challenges such as combating pest infestation, overcoming the problem of water to the site and time management, among others, during the project. Through conscious, collaborative efforts and the freedom to think critically, the PSST participants were able to address the challenges. “Critical consciousness is a process by which students learn to “think actively, and with intentionality and purpose” (Frymer, 2005, p. 6). Critical thinking and problem-solving skills empower students to be active partners in the community, confront the world and bring liberty without being pampered with knowledge by the teachers (Dewey, 1938; Freire, 1973; Major, 2014). Critical pedagogy, which is the lens through which this research was designed and interpreted, corroborates the need for awareness and conscientization of students leading to the ability to advance analytical ways of solving problems.

5.3 Focus on the Marginalized

According to the PSST participants, the harvests from the food gardens cultivated during the U-CE activity had the propensity to promote healthy living and good diet among the historically disadvantaged students with poor socioeconomic conditions, who reside in the university residence.

Simpson and Freeman (2004) submitted that health education and promotion must be linked, to a certain extent, to the circumstantial history of students instead of teachers strictly adhering to the rigid curriculum that puts pressure on the students. In other words, the authors concurred that critical pedagogy in health advancement must be

the subject matter (in health education) and practice (students' experience). Consequently, Giroux (2013a) asserted that "The new illiteracy is about more than not knowing how to read the book or the word; it is about not knowing how to read the world". The author inferred that students must be challenged beyond the content of the curriculum to become agents of change. Thus, PSSTs who participated in this project combined the following: the knowledge of Nutrition from EDBS 310, knowledge of nutrition from permaculture and IK specialists, who were experts external to the academic institution, hands-on experience obtained through food gardening and the awareness, through a research survey, of challenges faced by marginalized students in the university community. They also constructed knowledge about nutrients contained in crops and how to cultivate and maintain gardens by engaging in self-directed research. This enabled them to understand the potential of food gardening for responding to the challenges encountered by food-insecure students, the latter who are often marginalised and invisible in the HE landscapes.

Furthermore, the PSTs alluded to the position that U-CE using the garden activity could provide food security for students from disadvantaged backgrounds especially when their monthly meal allowances were exhausted. Through active engagement in this U-CE project, which included a research survey, PSST participants became conscientized of the economically marginalized and historically disadvantaged PSTs.

PSTs who participated in this project, and who were not biology students, were self-classified as emerging from the low socioeconomic background. Thus, many of the PST participants in the U-CE realized that through this project, poverty and poor nutritional conditions could be reduced among students from previously marginalized groups who were residing on the university campus residence.

Kincheloe (2008a, p.12) conceded that through critical pedagogy, students whose welfare has been distressed by "discrimination and poverty" can identify the roots of their miseries and challenge the power inherent in the oppression that stands against them. Teachers must help students not only to realize that some circumstances make them disadvantaged in life but also ensure that students recognize the need to stand against those issues that thwart their educational and socioeconomic achievements (Degener, 2001). The PSTs who participated in this research were from the previously marginalized group in South Africa. Their consciousness about low socioeconomic

conditions of students, in general, was raised, and they went on to take action that could potentially dissolve barriers to students' academic and social dreams. Therefore, through U-CE, most PSTs who participated in this project, were able to better identify their state of lack and believed that they could lessen the effects the power of poverty over them.

5.4 Collaboration and democracy

Furthermore, during this study, the PSST participants demonstrated teamwork to the extent that they were able to leverage one another's opinions and cooperation. Giroux (1984) rejected the traditional teaching method that prevents students from exerting themselves to the best of their abilities. He argued that communal interactions that support discourse, negotiations, and sharing of knowledge among students will collapse the veil that shields genuineness. The teaching and learning process is basic to egalitarianism, therefore the educational procedures employed in training people must enable the production of intellectuals who will be accountable, analytical, insightful and well-informed in the society (Giroux, 2011). Through collaboration, PSSTs who participated in this research became aware of the benefits of working as a team to cultivate the gardens successfully. The participants relied on one another's views on ensuring the success of the project. Giroux (2011, 170), while arguing for the critical pedagogy in education, stipulates that people need to be enlightened to the extent that they are enabled " to be border crossers capable of engaging, learning from, understanding and being tolerant of and responsible to matters of differences and otherness". This process of border crossing, with its concomitant requisites, is made possible through democratic collaboration. Effecting involvement in group activities by the group members of a group can result in collaboration which transcends to enablement for the group members to achieve the group goals (Agarwal, 2001; Mukoni, Mudaly, & Moletsane, 2018). The border crossing also occurred when PSSTs learned from the IK holder and embraced new knowledge from an unconventional source.

Furthermore, arguments have been advanced for accountability and accommodation of the indigenous knowledge in the curriculum by scholars (Le Grange, 2016). The importance of creating a relational paradigm called "an African-based relational paradigm that informs a postcolonial research methodological framework within which

indigenous and non–indigenous researchers can fit their research" is presented (Chilisa, Major, & Khudu-Petersen, 2017, p. 326). The authors contended that equal rights must be accorded to all research work and research procedures; regardless of place, people, capabilities or socio-economic factors, that can lead to "African relation epistemologies"(p. 326). The assertions by the authors stressed the value of democratization of the curriculum which was demonstrated by the collaborative endeavour by IK holders and PSSTs participants to include IKS in the U-CE project. "Collaboration and mutual capacity building are the characteristic elements of transformative research" (Khupe, 2014, p. 86). The author predicted that the partnership between indigenous knowledge practitioner and the researcher is crucial in enhancing social justice.

5.5 Empowerment

Participants' experiences of becoming empowered were underscored by most PSSTs who engaged with U-CE in this study. The PSST participants concurred that through U-CE, they had been empowered and strengthened for their future role as professional teachers. This position corroborated the principle of empowerment in critical pedagogy. The need to equip pre-service science teachers using the pedagogy that will enhance their proficiency in dealing with community-based issues relevant to equity has been highlighted (Khupe, 2014).

Notably, Giroux (2010) agreed that critical pedagogy is the teaching and learning process that uses the tenet which accentuates students' realization of liberty, oppression, power dynamics, and capacity to act by doing something for their liberty. Nikolakaki (2012) concluded that students' internal intelligence requires an uprising that will change the status quo in the world of their incapacitation and bring about independence. Scholars argued that critical pedagogy must be pertinent to the culture, driven by stakeholders and be communally empowering (Farinde-Wu, Glover, & Williams, 2017; Freire, 1993; Lankshear, McLaren, & McLaren, 1993; Quigley, 1997).

The PSSTs who participated in this study realized that their learning about food gardening could empower them to transcend the conventional role of the Life Sciences teacher, by empowering their communities to learn food gardening to address food insecurity. The participants attained conscious freedom, confidence, and inspiration,

which transformed their identity from that of a novice who was unaware of the impact of food gardening to address food insecurity, to becoming citizens who were eager and prepared to contribute to the social transformation of the communities in which they would practice in the future. Students in the institutions of higher learning must be made to participate in community engagement projects to become citizens who will support the efforts of transformation in South African society (Maistry & Thakrar, 2012). The authors submit that there could be unintended consequences if university students do not participate in community engagements.

To bring about social change, PSSTs who participated in this study were guided by the lecturer to resist the status quo, which focused the learning on physiology and anatomy about nutrition in biology. They transcended this boundary, by learning about nutrition using a social justice (as opposed to a biomedical) approach, by focusing on nutritional challenges of food-insecure students and the health benefits of garden food. The U-CE activity was not the conventional activity that would have been expected in a biology class. The knowledge that PSSTs constructed was not neutral but was both political and enabling.

Giroux (2011) rejected that pedagogy where students are degraded to what resembles jovial mechanical devices which cannot develop initiatives of morality, control, integrity and principles that affect the society. He further argues that the community life and the higher education institutions must not operate parallel to each other, but rather educational practitioners must link teaching and learning with the challenges affecting humanity. The role of critical education in educational institutions cannot be overemphasized (Postma, 2015; Sultana, 1992). These authors' views are supported by Kincheloe (2008a, p. 112) who states that "social justice should be a foundational principle on which we build our teacher education program". The author affirms that pre-service teachers and in-service teachers should not teach learners in isolation of the social circumstances prevailing in the society. Ira Shor (1992) concludes as follows:

> Students learn to be passive or cynical in classes that transfer facts, skills, or values without meaningful connection to their needs, interests or community cultures. To teach skills and information without relating them to society and to the students' contexts turns education into an authoritarian transfer of official

> words, a process that severely limits student development as democratic citizens (Shor, 1992, p. 18).

Far from adopting an authoritarian approach, participants in this study related skills and information to students' contexts. The PSST participants in this study developed civic courage because they taught the NBPSTs how to cultivate the food garden which was in response to the needs of the community of students residing on the university campus. Therefore, the experience gained during U-CE would be transferred to their communities where there is the need for related civic duty making their education radical. The PSSTs who participated in this study viewed themselves as agents of change in their future working environments.

Giroux (2004, p. 34) argued that "critical pedagogy emphasizes critical reflexivity, bridging the gap between learning and everyday life, understanding the connection between power and knowledge, and extending democratic rights and identities by using the resources of history". Reflexivity facilitates individuals to recognize and defeat the power of intimate and societal issues, such as classism and inequalities, that limit their progress in life through self-consciousness and hindsight (Bisset, Tremblay, Wright, Poland, & Frohlich, 2015; Houston, 2015). Consequently, in U-CE, reflexivity revealed the political and the power imbalance which contextualized the PST participants' situation that engaged in this research. Thus, through U-CE, the PSTs were able to bridge the gap between learning and everyday life. In other words, PSTs who participated in this project understood the connection between power and knowledge because they indicated that they could become independent and would not have to rely on the government if they found themselves to be unemployed (in the future) which signalled freedom.

Shor and Freire (1987) maintained that knowledge reconstruction is a two-way procedure and through the inquiry process, students can answer critical questions the teacher inquiries from them. The facilitation of knowledge construction was unconventional in this study because it departed from the dominant narrative lecturing approach. Instead of alienating students, they were guided to engage in a hands-on gardening activity, based on and informed by research activity, and to develop the capacity in non-biology students simultaneously. Through these forms of engagement, the PSSTs were empowered.

5.6 Transformation, Emancipation and Identity formation

The PSSTs who participated were guided by the lecturer to research the nutritional and health needs of the student community that resided in the university campus residence. They then determined what type of food crops to plant independent of the lecturer. This initiative by the lecturer borders on helping the participants to enhance their academic productive process in terms of idea generation and facilitating them to rewrite their perceptions and experiences.

Critical pedagogy "stressed empowering learners to think and act with the aim of transforming their life conditions" (Aliakbari & Faraji, 2011). Teachers in critical pedagogy must be transformative intellectuals who engage the students in a thought-provoking teaching and learning process that develops the students' proficiencies and knowledge in craving to transform social imbalances through creating a dialogue between them and the students (Giroux, 1997; Sadeghi, 2008). The transformation posture of the teachers will enable the students to challenge dictatorial power that exists in the learning space, the scholars argued. Accordingly, the lecturer who taught the biology module where the PSSTs were guided to carry out U-CE, could be perceived to be a transformative intellectual. Moreover, PSSTs who participated in this study had a vision of empowering their communities. They envisaged a changed professional identity from regular teachers to transformative intellectuals. Giroux (1983) insisted that if the education of social responsibility must be enfranchising, its fundamental objective would be to arouse the brainpower of students to challenge social, political and economic ills that prevent the students from attaining their societal success. The author adds that giving the students the space to participate in the pedagogical process is democratic and political instead of responding to the few who are advantaged students among the whole class.

The willingness by PSSTs who participated in this project, to work with NBPST participants in U-CE, is an example of volunteerism. Volunteerism, according to Stukas, Snyder, and Clary (2015, p. 459) is a "form of prosocial behaviour that involves a freely chosen decision to commit a sustained amount of time and effort to helping another person, group, or cause, typically through a non-profit organization". Cnaan et al. (2010) asserted that volunteering by students is vital because students who engage in offering themselves to community engagement projects are diligent within

their higher education institutions and the community at large. Therefore, the suggestion by the PSTs for more students to be involved in U-CE, according to the data, indicates the preparedness on the part of the future teachers to promote citizenship and social agency amongst themselves.

According to Freire (1973), critical consciousness symbolized events that are interwoven into actuality, measurable both in root cause and contexts. The pedagogy offered in educational institutions should assist marginalized students to identify the situations that conspire against their educational and socioeconomic status with the aim of transforming the unhealthy conditions to favourable situations (Degener, 2001). The NBPSTs who participated in this U-CE project were self-classified as emerging from disadvantaged backgrounds where poverty was prevalent. More so, the experience of a lack of food for healthy sustenance could be traumatic and could lead to self-defeatism. This form of experience could harm students which Dewey (1938, p.8) affirmed as follows:

> "The belief that a genuine education comes about through experience does not mean that all experiences are genuinely or equally educative. Experience and education cannot be directly equated with each other. For some experience are miseducative that has the effect of arresting or distorting the growth of further experience. An experience may be such as to engender callousness; it may produce lack of sensitivity and responsiveness. Then the possibilities of having richer experience in the future are restricted".

In this study, participants were guided into rich experiences that deepened their consciousness of social challenges, heightened their sensitivity to food insecurity and enabled them to develop ways to respond to food insecurity. The identities of the PSSTs were also influenced after partaking in the U-CE project. The PSSTs realized that merely standing in the front of learners to teach a prescribed syllabus was not enough and they needed to add citizenship duties to their professional skills.

Critical pedagogy stressed critical reflexivity which brings about change in the psychological state of students leading to emancipation from self-defeat and leading to independence. Therefore, I argue that through critical pedagogy, this status quo in which experience has rendered historically disadvantaged people as self-defeatist or

pessimistic can be disrupted through U-CE. In addition, the implementation of U-CE can be one way of emancipating historically disadvantaged students.

5.7 Conclusion

This chapter has provided an analysis of the data of this research using the CP theory of Henry Giroux and other CP theorists. Five principles of CP, namely, evaluating consciousness, focusing on the marginalized, collaboration and democracy, empowerment, transformation, emancipation, and identity formation were applied in the data analysis.

Finally, the next chapter (chapter six) will discuss the findings and recommendations of this study.

CHAPTER 6: SUMMARY, RECOMMENDATIONS, AND CONCLUSIONS

6.1. Introduction

This chapter presents the summary of the findings, recommendations, and conclusions that emerged from this study titled, exploring university-community engagement by pre-service science teachers through the study of a biology module. It also proposed a U-CE model that emerged from the insights of this study. The findings, whose data were generated from multiple sources, were inductively analysed. Thus, this chapter offers a holistic review of the answers to the four research questions of this study. These four research questions are as follows: Firstly, 'How do pre-service science teachers implement university-community engagement through their study of a Biology module'? Secondly, 'What are pre-service science teachers' views about requirements for effective university-community engagement through a Biology module? Thirdly, 'What are pre-service science teachers' views about how university-community engagement can influence the well-being of students at a university'? and fourthly 'How does engaging in a university-community engagement project influence pre-service science teachers' professional identity for their future practice?

6.2 Summary of significant research findings

Table 11: Summary of findings from Research Question One

Research Question	Overall finding	Themes
Research Question One: How do pre-service science teachers implement university community engagement through their study of a biology module?	Implementation of U-CE requires adequate planning, preparation, and teamwork among PSSTs	1. Acquire knowledge of food gardening 2. Collaborative effort of pre-service science teachers (PSSTs) 3. Self-directed research based on the nutritional and health needs of students 4. Use of problem-solving skills

Table 11 provided the summary of the overall finding and Themes for the Research Question One of this study which is: How do pre-service science teachers implement university-community engagement through the study of a biology module?

Theme one revealed that there was a need for PSSTs who participated in this study to attain the knowledge of the food gardening procedure. This acquisition was essential in the implementation of U-CE, even though the participants were biology inclined and learning the topic ‘Nutrition’ as part of the EDBS 310 course outline. According to the data that emerged from different sources under Theme 1, the PSST participants voiced their views about acquiring information with regard to indigenous ways of cultivating and maintaining food gardens which they were not familiar with before embarking on this project. In addition, the PSST participants stated that they learned about the permaculture method of gardening which was an environmentally friendly way of vegetable crop production. This knowledge acquisition was essential in the implementation process.

Secondly, it emerged from Theme 2 that collaboration and teamwork played a crucial role in effecting U-CE by PSSTs who participated in this study. There was the division of labour among the participants on how the responsibilities of the projects should be shared. It was also evident that PSSTs displayed mutual respect, working as a team towards the same shared goals as groups, commitments to time of meeting despite busy schedules that require them to attend lectures, do and submit assignments. There were six groups of PSSTs, and each group indicated a jointly developed structure and timetable for carrying out the routine of the food gardening. Also significant was the commitment to contribute some money to buy seeds for the project as team members while the use of WhatsApp app in the smartphones of many of the participants ensured that members of each group kept in touch regularly.

Thirdly, the data that emerged from Theme 3 suggested that it was pertinent for PSST participants to identify the nutritional needs related to the healthy living of the students’ community before embarking on the U-CE project. Because of this thought, the participants did a survey and self-directed desktop research which revealed that some students in that university residence experienced night blindness, cardiovascular conditions, anaemia, and high blood pressure. The PSST participants also investigated the possible nutrients and functions of a variety of food garden crops that could be planted and utilized to mitigate the health conditions found to be affecting some of the students in the campus community. Further, food garden crops such as

carrots, spinach, beetroot and amadumbe (*Colocasia esculenta),* an indigenous crop, were cultivated.

In Theme 4, it emerged that certain challenges could be encountered while engaging in the U-CE project which would necessitate problem-solving abilities. Pre-service science teacher participants alluded to having to create ways to combat disease infestation on their gardens without using chemical pesticides, which was one of their briefs. They had to find ways to control the insect pests by using ashes and garlic sprays. This creative way of pest control was environmentally friendly and ensured the protection of the food crops that were planted.

The overall finding in the answering of Research Question One of this study is that adequate preparation and teamwork are critical when U-CE is to be implemented. The elements for the overall finding were summarized in the preceding paragraphs.

Table 12: Summary of findings from Research Question Two

Research Question	Overall finding	Themes
Research Question Two: What are pre-service science teachers' views about requirements for effective university-community engagement through a biology module?	Effective U-CE entails a collaboration between students and the university management	1. Student-driven Initiatives 1. Involvement of more students from the university community in the project 1.2 Sustainability of the project 2. University-driven Initiatives ○ University management to motivate a greater number of students to engage in food gardening ○ Provision of more land to expand the food garden project by the university. ○ Provision of more tools for food gardening by the university

Table 12 highlights the findings that emerged from the data that answered the Research Question Two of this study which states: What are pre-service science teachers' views about requirements for effective university-community engagement through a biology module? Two Themes were revealed with the first having two sub themes while the second has three sub-Themes.

Theme 1 captured the views of both sets of participants, PSSTs, and NBPSTs, concerning the requirements for effective U-CE through a biology module. Most of the participants agreed that the scope of the project could be expanded to include students across many disciplines in the university instead of it being limited to the biology students to implement. The participants stressed that the positive effects of the food garden project, under the U-CE program, could have a far-reaching impact at the homes of the students in alleviating food insecurity. Additionally, the participants concurred that the U-CE project should not be a once-off program but rather a continuous engagement because it has the propensity of improving the nutritional wellbeing of students living both on and off-campus residences.

Moreover, Theme 2 of the Research Question Two explained the role that university management must play in the support of the U-CE project. The findings indicated that the university authority should advertise for more students to be part of the project, provide adequate plots of land, tools, and equipment for the food garden project. Some of the PSST participants expressed their frustration in trying to secure tools such as spades and hoes for the cultivation of their garden plots which informed the need for the university administration to ensure that tools were available for the projects, on time and in the future. Furthermore, most of the participants alluded to the fact that if the university can be one of the main drivers of the project, it can help to fight poverty and develop food gardening skills among students who reside in the campus residence.

In addition, the overall finding for Research Questions Two stipulates that for U-CE to be an effective collaboration between students and the university management is compulsory where the students and university authority drive the process simultaneously.

Table 13: Summary of findings from Research Question Three

Research Question	Overall finding	Themes
Research Question Three: What are pre-service science teachers' views about how university-community engagement can influence the well-being of students at a university?	U-CE has the potential to positively improve the nutritional and social well-being of students who reside in a university campus residence.	1. Promotion of good health and diet 2. Food security amongst the PSTs 3. Self-reliance 4. Poverty reduction among PSTs

The summary of findings to the Research Question Three: What are pre-service science teachers' views about how university-community engagement can influence the well-being of students at a university? This is outlined in Table 13. Four themes were generated from the data set of different sources.

Theme 1 provided that the U-CE projects can promote good health and diet for the students residing in the residence with health challenges related to nutrition. Many of the participants asserted that the nutrients in some of the garden crops planted may not necessarily cure some of the health conditions but could manage and control them. The example of beetroot, a vegetable crop rich in iron, was cited by some of the participants to be effective in reducing the negative effect of anaemia and restoring the haemoglobin in the blood. Amadumbe, an indigenous plant, had been found to contain antioxidants that neutralise free radicals in the human body system thereby strengthening the immune system of the body. More so, spinach had been identified by the PSST participants, to have low cholesterol which can alleviate high blood pressure among residence students who have such a health condition. It should also be noted that most PSST participants agreed that the eating of the food garden crops by residence students will encourage a healthy diet. It was observed by the participants that many students do not eat proper food but rather patronise the students' cafeteria on campus to purchase fast food such as fried chips and other unhealthy meals that are high in calories but poor in the essential nutrients required by humans for well-being.

Theme 2 of Research Question Three revealed that the U-CE project could mitigate hunger and food insecurity that affected the student community that resides on the university campus. The PSST and NBPST participants unanimously expressed that the harvest from the food garden can help students struggling financially to feed themselves and eat proper food. Many of the participants in this study affirmed that,

even though some of the students, who came from low socioeconomic backgrounds and resided in the university residence, received funding from NSFAS, a South African government funding agency, they still suffer from food insecurity. Thus, this U-CE initiative can provide some succour to the food challenge that the less privileged students could be facing.

In Theme 3, the findings pointed out that U-CE can enable pre-service teachers to think of being self-reliant in terms of being food secure. The experience that the participants gained during this project informed that students residing in the university campus residence could set up garden farms to support themselves and their families even if they must do it on a commercial basis. The case of high unemployment in the country, at the time of obtaining the data for this study, was cited which most of the participants viewed as a motivation to act rather than wait for the government to do most things for them as citizens of South Africa.

Theme 4 of the Research Question Three expressed the extent of the impact of the U-CE project on the participants' views regarding poverty. The data that emerged indicated that PSTs felt that the project could alleviate poverty among poor students if they are well empowered to carry out the food gardening project.

The overarching finding from Research Question Three is that U-CE has the potential to positively improve the nutritional and social well-being of students who reside on university campus residences.

Table 14: Summary of findings from Research Question Four

Research Question	Overall finding	Themes
Research Question Four: How does engaging in a university-community engagement project influence pre-service science teachers' professional identity for their future practice?	Engaging in U-CE can raise the consciousness of PSSTs towards attaining professional identity for their future practice. A pedagogy of conscience is argued for. University-community engagement can facilitate the process of being a teacher to becoming a teacher	1. Empowerment 2. Agency through activism

Table 14 presents the summary of the findings that emerged from the Research Question Four of this study that states: How does engaging in a university-community

engagement project influence pre-service science teachers' professional identity for their future practice? Two themes were developed based on the data generated from the study.

Theme 1 stated the notion of empowerment which most of the PSST participants supported as being significant to their qualities as future teachers or professional identities of becoming teachers in the future. Vokatis and Zhang (2016, p. 74) asserted 'the new professional identities involve teachers as vision-driven professional knowledge builders; as problem-solvers to address contextual challenges; as co-learners with students; and as innovative collaborators with colleagues". Thus, PSSTs who participated in this study became critically conscious and empowered that *as a future life science teacher, it is not only based on standing in front of learners but also involving them in such activities (like food gardening)* – (11 PSST1). The appreciation of the context of the teaching environment to offer to make teaching more practical to the learners was revealed through this finding. Izadinia (2013), asserted that self-awareness and critical consciousness are fundamental in the development of student-teacher identity for their future practice.

The Theme 2 of Research Question Four of this study revealed that the mindsets of the PSST participants were further aroused to become agents of change in the society locality they eventually will find themselves working in as professional teachers in the future. Most of the PSST participants envisaged that they may find themselves working in deep rural and poverty-stricken communities in the future and felt that expanding the knowledge and practice of the food gardening to those areas could alleviate the challenge of the impoverishment. Most of the public schools in South Africa are in the poor geographical areas in townships, rural areas, and are non-fee paying that are referred to as Quintile 1 – 3 schools (Ogbonnaya & Awuah, 2019; Venkat & Spaull, 2015; Western Cape Government Education, 2013). According to Karaolis and Philippou (2019, p. 399), "the main contribution to the process of teacher professional development, its construction and reconstruction, comes from the part of the individual, through the processes of interpretation, self-reflection, and agency despite the influence of social relationships and context". Therefore, I argue that the PSST participants in this study became conscious of becoming agents of change, when they

become professional teachers, in any poor community they find themselves teaching Life Sciences.

6.3 Recommendations: Insights derived from findings

This study titled exploring university-community engagement by pre-service science teachers through the study of a biology module sought to address the paucity created by the inadequate literature on food insecurity among the university student community, recommends an evidence-based process of implementing U-CE in the university community using critical pedagogy.

The insights derived from my findings originated from the overall findings stated in Tables 11-14. These insights are represented in the following Figure 22:

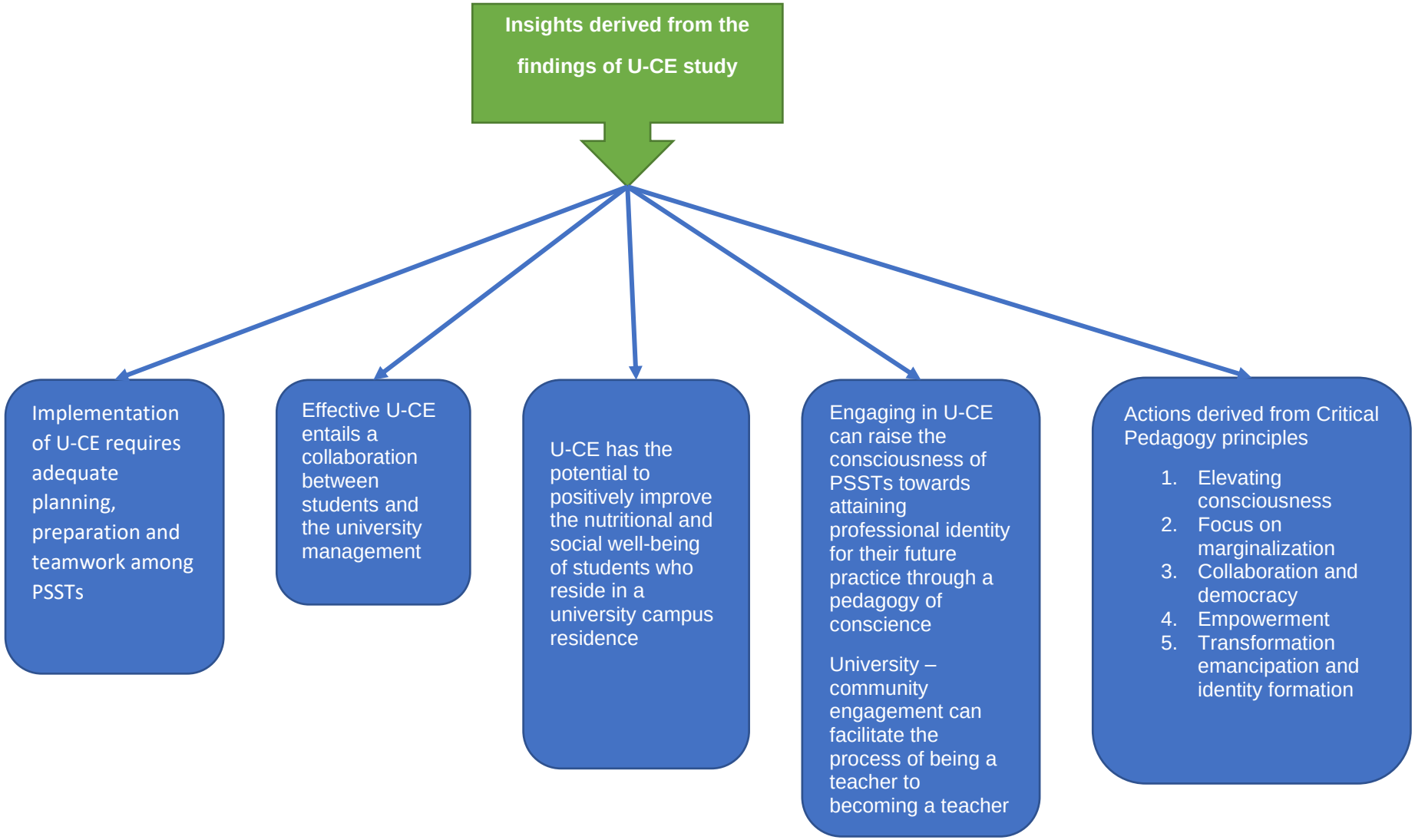


Figure 22: Diagrammatic representation of insights from the findings of U-CE study

6.3.1 Insight one: Implementation of U-CE requires adequate planning, preparation, and teamwork among PSSTs

According to the insight one that emerged from the findings of this study, it is appropriate that U-CE projects in the universities meant for the upliftment of students' nutritional well-being be planned adequately and managed by students communally. Planning must involve the investigation and identification of the ardent matters, wishes, and interests of the community a project is intended for to make that community receive the project as its own which ultimately increases the success rate of the project (PennState College of Agricultural Sciences, 2019; USAID, 2011). Similarly, the student community that was residing in the university campus where this study was carried out was consulted and a survey was made by the PSST participants which culminated in self-directed research by the PSST participants. The PSST participants, in their quest of linking the knowledge of biology to the benefit of the students' community, sought more information on food gardening based on the nutritional and health benefits of the NBPST participants.

Furthermore, Giroux (2018, p. 508) asserted that "critical pedagogy is situated within a project that views education as central to creating students who are socially responsible and civically engaged citizens". The author added that team effort and creativity are essential among the students to develop the abilities for taking crucial action in society. Working together in groups by the PSST participant to creatively identify critical issues affecting the community and proffering practical solutions to such problems transcended the traditional pedagogy where the teacher is the one who gives all the guidance. Thus, when students are permitted to work unguided by their teacher, it takes away the notion that students are mechanical devices (Giroux, 2011). A *pedagogy of conscience* is thus conceptualized in this manner.

6.3.2 Insight two: Effective U-CE entails a collaboration between students and the university management

In this study, instead of the students protesting about financial and consequently food deprivation, students chose to challenge the issue of food insecurity and nutritional well-being by learning the what, how and why about food gardening. Several issues such as an increase in tuition fees, call for free education, funding for students of

previously disadvantaged background have resulted in protests in many South African universities over the last decade (Jansen, 2018). These protest actions by students, according to the author, had made the university management act as managers of government entities such as the municipalities that deal with public protests regularly. However, the PST participants in this study did not contemplate the thought of protesting against the university management but rather chose the food gardening project as one of the ways students who were from a previously marginalized group and poor socioeconomic backgrounds could confront the issue of food insecurity. Thus, the suggestion by many of the participants that the U-CE project should be made available for all students across different disciplines in the university was unanimous.

In addition, the call for collaboration, partnership and more involvement of the university management to support the project by providing more plots of land and tools can be viewed as democratic action being displayed by the participants. Drinkwater (2014, p. 2) advocated for a democracy for students referred to as “robust global democracy which requires the free and full participation of its citizens through critical inquiry, dialogue, discussion and debate from multiple perspectives and active engagement to challenge the status quo in the pursuit of a more just and inclusive society”. The author argued that the voices of the marginalized students must be encouraged to form part of the decision-making process because they have relevant lived experiences to share which can lead to their emancipation when the opinions are taken into consideration by the relevant authority. Furthermore, Cook and Nation (2016) suggested that universities should use their resources more to help marginalized groups or communities develop social action attributes and build power through collective actions as citizens. This view of the author will enable the community members to be egalitarian and more participative in the democratic process of the society. Therefore, I recommend that a democratic collaboration among students undertaking U-CE, student community, and the university management will go a long way in alleviating nutritional stress and food insecurity among students who reside on the university campus facing these challenges during their stay on campus and even after leaving the university environment.

With the myriads of issues confronting the implementation of the conventional UCE in South African universities, Snyman (2014) suggested that universities must draw up well-defined blueprints on CE, provide adequate incentives for the projects and ensure

that there is proper internal supervision and appraisal of CE activities. Additionally, efficient delivery of UCE requires a university to have a proper policy on community engagement, provide adequate orientation for the community members, make the value proposition of the program and monitor the impact and feedback of the project (Kearney, 2015). Consequently and as revealed from insight two of this study, I will recommend that a well-dedicated office be created for U-CE and other UCE projects, a clear-cut policy made, ample resources provided and strict monitoring and assessment procedure in place for the effective implementation of U-CE projects in the university.

6.3.3 Insight three: U-CE has the potential to positively improve the nutritional and social well-being of students who reside in a university campus residence

The collaboration between the food secure PSST participants and the food insecure NBPST participants provided NBPSTs with the skills to undertake food gardening on their own if they so choose. In this way, NBPST participants were enabled to make a change in their food-insecure status. The pedagogy and process the PSST participants utilized in implementing U-CE made the NBPST participants who resided in the university campus community to be exposed to better ways of eating healthily, being self-reliant about food gardening, and discovering that the U-CE project can help alleviate poverty among poor students from a low socioeconomic background. In my view, this insight is emancipating. Accordingly, “Education in critical pedagogy is a potentially liberating process in that it has the potential to raise students’ consciousness, help students develop a more accurate perception of their experiences, empower students to challenge oppressive social conditions and to work toward a more just society” (Morris, 2015, p. 161).

Furthermore, I recommend that the university pay more attention to U-CE because it has the potential to positively improve the nutritional and social well-being of students who reside in a university campus residence thereby raising the consciousness and is emancipatory.

6.3.4 Insight four: Engaging in U-CE can raise the consciousness of PSSTs towards attaining professional identity for their future practice through the pedagogy of conscience.

Through this study, the PSST participants became more conscious and more resolute to go out into the field of teaching and make a difference in the lives of the learners and the communities where they may find themselves teaching in the future. Some of the elements of student-teacher professional identity as identified by Izadinia (2013, p. 708) were “self-awareness, sense of agency, critical consciousness, relationship with colleagues, cognitive knowledge, confidence, and teacher's voice” were revealed from this study which formed the basis for insight four. These attributes indicated that through U-CE, pre-service teacher professional identity can be developed. Hence, U-CE can facilitate the process of being a teacher to becoming a teacher.

Therefore, I recommend that the government and the curriculum developers make a serious consideration into exploring the significant impact insight four of this U-CE study will have on the caliber of teachers in the educational system of South Africa.

6.4 Adebayo’s Model on University-Community Engagement (AU-CE)

AU-CE model in Figure 23 was conceptualized based on the findings and insights of this study. This model integrates U-CE with the Infusion (cross-cutting) model.

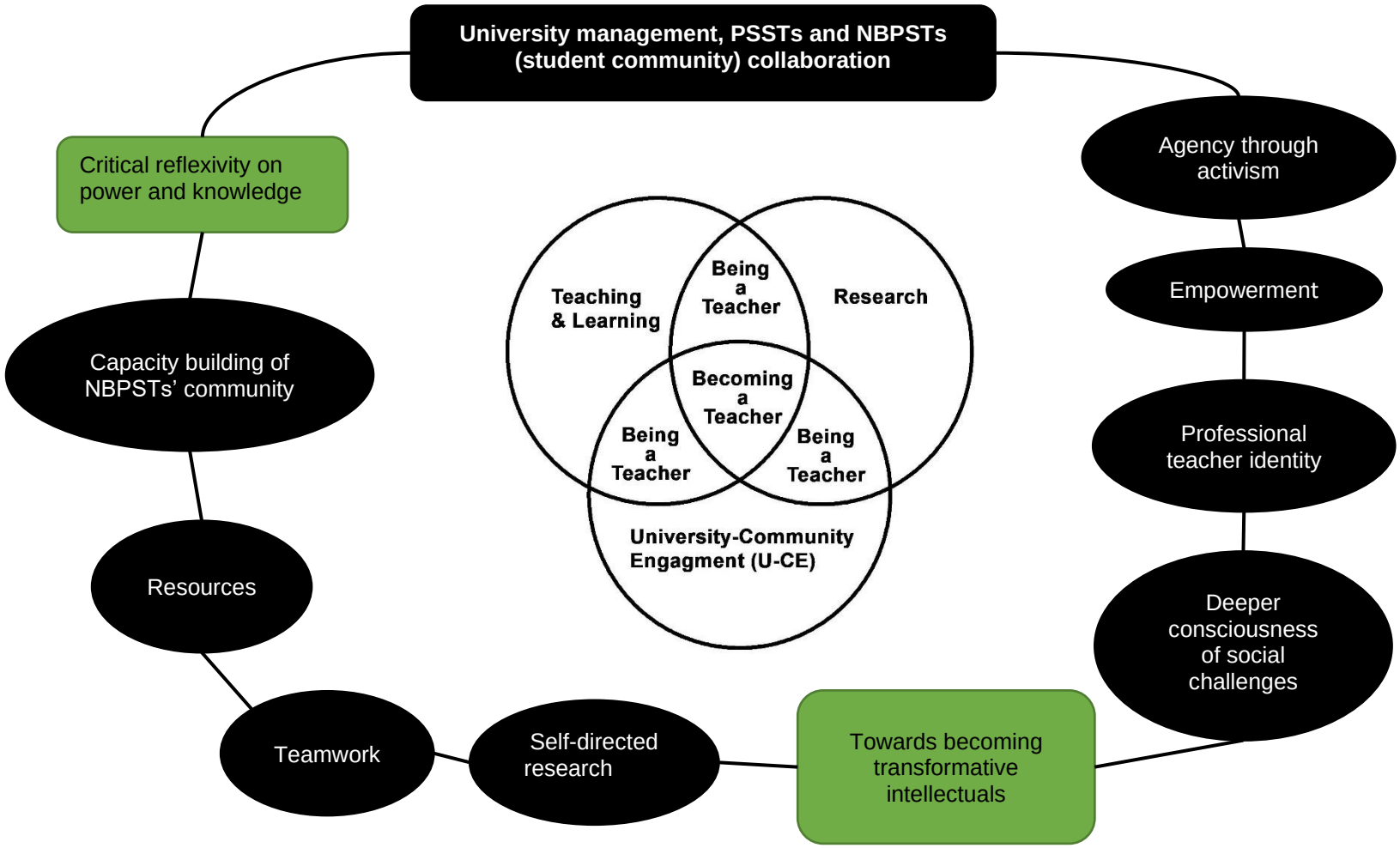


Figure 23: Adebayo's model on University-Community Engagement – Adebayo University-Community Engagement (AU-CE)

AU-CE recognizes the importance of research and teaching and learning as two core functions of the university that should interact with U-CE to ensure their effectiveness. Through the findings and insights of this study, a collaboration among the university authorities and students implementing U-CE is recommended. The staff of the university could support the project through different research activities to develop adequate and reliable data from the projects while simultaneously implementing the pedagogy of conscience to train preservice teachers.

From critical reflexivity on power and knowledge and capacity building of the student community is developed during U-CE. Elements such as the provision of resources by the university management, teamwork among the preservice teachers implementing the project and self-directed research guarantee a well-executed U-CE. Additionally, pre-service teachers become transformative intellectuals who develop deeper consciousness of social challenges, professional teacher identity, empowerment and agents of change before becoming professional teachers. This preparation of teachers is significant in social transformation.

PSSTs developed an identity of ‘becoming teachers’ as opposed to ‘being teachers. ‘Becoming a teacher’ transcends the teaching of the content. It involves developing an identity of activism and developing into an agent of change in society. Hence, the assertion ‘Becoming a teacher’ reverberates with the principles of CP which includes transformation and emancipation of the oppressed for the betterment of the society. The ‘becoming a teacher’ enumerates the civic nature of the political and practical aspects of citizenship.

Finally, it is my view that the AU-CE model, which is one of my contributions to the body of knowledge can support the urgent need to find solutions to the myriads of socioeconomic challenges affecting university students, other undergraduate students in South Africa and in other parts of the world.

6.5 The implication for further research

The existence of U-CE as conceptualized in this study is scarce in the literature. The universities that undertake CE implement the conventional UCE which embodies the interaction, partnership, and collaboration with neighbouring and regional communities in a mutual engagement or to alleviate social ills in those communities. For the student community to be accommodated in the CE, which is a core function of the university, further research will be suggested to interrogate how U-CE can contribute more to the alleviation of hunger, food insecurity and nutritional well-being among the student community residing in the university campus residences.

6.6 Conclusion

This chapter provided the details of the findings, summary, recommendations from the insights, implications for further research and a model for implementing U-CE in a public university in KwaZulu-Natal province of South Africa.

The findings revealed that U-CE implementation is possible with astute planning, teamwork, and research activities by the PSSTs in conjunction with NBPSTs who form members of the student community. The partnership of the project with the university authority is essential with regard to providing necessary logistics and material support for the project. More so, the implementation of U-CE has the capability of bringing about awareness, change, and improvement in the nutritional diet and well-being of the student community that may be from poor socio-economic backgrounds who are food insecure. Besides, skills development of food gardening is acquired by NBPSTs who resided on the university campus because they volunteered to assist the PSST participants during the process. The students, both groups of PSST and PST participants were conscientized about the reality of using the U-CE project to break the cycle of poverty.

In relation to the theoretical framework, through critical pedagogy, participants became emboldened, empowered, and developed sensitivity for transformation, emancipation, collaboration, and democracy. The participants realized that the project raised their conscious minds and it was focused on the previously marginalized members of the students' community who were historically disadvantaged in the university. Furthermore, the participants became pedagogues in the process.

Based on this study I wish to add a new concept termed the '*pedagogy of conscience*' which resonates with the way the participants in this study had become more conscious of benefits of indigenous knowledge, student community's plights, offered to help the community, realized that U-CE could be used to solve part of the society's socioeconomic problems, became transformational and developed teacher professional identity.

REFERENCES

Abulon, E. (2014). *Basic education teachers' concept of effective teaching: inputs to teacher education curriculum in the Philippines.* Paper presented at INTED2014, 10-12 March, Valencia, Spain.

Acevedo Pérez, I., Rapiman, M. E., Cáneo Orellana, M., & Rueda Castro, L. (2017). Seven ethical requirements for quantitative and qualitative research in nursing: experiences of three research ethics committees from Santiago, Chile. *International Journal of Humanities and Social Scienc, 7*(7), 19-24.

Aftandilian, D., & Dart, L. (2013). Using garden-based service-learning to work toward food justice, better educate students, and strengthen ampus-community ties. Retrieved 23 November 2018 http://jces.ua.edu/using-garden-based-service-learning-to-work-toward-food-justice-better-educate-students-and-strengthen-campus-community-ties/

Agarwal, B. (2001). Participatory exclusions, community forestry, and gender: an analysis for South Asia and a conceptual framework. *World Development, 29*(10), 1623-1648.

Albertyn, R., & Daniels, P. (2009). Research within the context of community engagement. In E. Bitzer (ed.). *Higher education in South Africa: a scholarly look behind the scenes*, (pp. 409-428). Stellenbosch: SUN MeDIA.

Aliakbari, M., & Faraji, E. (2011). *Basic principles of critical pedagogy.* Paper presented at the 2nd International Conference on Humanities, Historical and Social Sciences IPEDR. 21st to 23rd October, Cairo, Egypt.

Almas, A., Hameed, A., & Sultan, F. A. T. (2008). Knowledge of coronary artery disease (CAD) risk factors and coronary intervention among university students. *The Journal of the Pakistan Medical Association, 58*(10), 553.

Alsup, J. (2006). *Teacher identity discourses: negotiating personal and professional spaces*. New York: Routledge.

Alvesson, M., & Willmott, H. (1992). On the idea of emancipation in management and organizational studies. *Academy of Management Review, 17*(3), 432-464. doi:10.5465/AMR.1992.4281977

Alvi, M. (2016). A manual for selecting sampling techniques in research. Retrieved 24 August 2019 https://mpra.ub.uni-muenchen.de/70218/1/MPRA

Amao, I. (2018). Health benefits of fruits and vegetables: review from Sub-Saharan Africa. In M. Asaduzzaman & T. Asao (Eds.), *Vegetables: importance of quality vegetables to human health* (pp. 33). London: IntechOpen.

Ammentorp, L., & Madden, L. (2018). Learning from others: developing preservice teachers' workplace skills*. The Educational Forum*, *82*(1), 85-96.

Appe, S., Rubaii, N., Líppez-De Castro, S., & Capobianco, S. (2017). The concept and context of the engaged university in the global south: lessons from Latin America to guide a research agenda. *Journal of Higher Education Outreach and Engagement, 21*(2), 7-36.

Arts, J., Fernandez, M. L., & Lofgren, I. E. (2014). Coronary heart disease risk factors in college students. *Advances in Nutrition, 5*(2), 177-187.

Asghar, J. (2013). Critical Paradigm: a preamble for novice researchers. *Life Science Journal, 10*(4), 3121-3127.

Astalin, P. K. (2013). Qualitative research designs: a conceptual framework. *International Journal of Social Science and Interdisciplinary Research, 2*(1), 118-124.

Atawodi, S. (2005). Antioxidant potential of African medicinal plants. *African Journal of Biotechnology, 4*(2), 128-133.

Atkins, L., & Duckworth, V. (2019). *Research methods for social justice and equity in education*. London: Bloomsbury Publishing.

Avidov-Ungar, O., & Shamir-Inbal, T. (2017). ICT Coordinators' TPACK-based leadership knowledge in their roles as agents of change. *Journal of Information Technology Education, 16*(1).

Aziz, H. A., & Gomaa, A.-S. (2017). Coronary heart disease risk factors among university female students. *Quality in Primary Care, 25*(4), 229-234.

Balampekou, M., & Floriotis, G. (2012). Antonio Gramsci, education and science. *Journal for Critical Education Policy Studies, 10*(1), 285-297.

Bandeen, H., & Paul, S. (2018). Toward persistence: contemplative practices in community college teacher education programs. In K. Brynes, E. J. Dalton, & E. H. Dorman (Eds.), *Cultivating a culture of learning: contemporary practices, pedagogy, and research in education*. Maryland: Rowman & Littlefield.

Bandy, J. (2016). *What is service learning or community engagement.* Center for Teaching, Vanderbilt University. Retrieved 10 November 2018: https://cft.vanderbilt.edu › teaching-through-community-engagement

Bandy, J. (2018). What is Service learning or community engagement? Center for Teaching, Vanderbilt University. Retrieved 10 November 2018 https://cft.vanderbilt.edu/guides-sub-pages/teaching-through-community-engagement/

Barnum, A., & Illari, J. (2016). Teaching issues of inequality through a critical pedagogy of place. *Journal of Sustainability Education, 25*(11), 1240-1244.

Bauer, M. W. (2000). Classical content analysis: a review. In M. W. *Bauer* & G. Gaskell (Eds.) *Qualitative researching with text, image and sound* (pp. 131-151) Los Angeles CA: Sage.

Baxter, P., & Jack, S. (2008). Qualitative case study methodology: study design and implementation for novice researchers. *The Qualitative Report, 13*(4), 544-559.

Bazeley, P. (2009). *Integrating data analyses in mixed methods research*. Los Angeles, CA: Sage:.

Bednarz, S. W., Chalkley, B., Fletcher, S., Hay, I., Heron, E. L., Mohan, A., & Trafford, J. (2008). Community engagement for student learning in geography. *Journal of Geography in Higher Education, 32*(1), 87-100.

Begley, G. S. (2013). Making connections: service-learning in introductory cell and molecular biology. *Journal of Microbiology & Biology Education: JMBE*, *14*(2), 213.

Bellavia, A., Larsson, S. C., Bottai, M., Wolk, A., & Orsini, N. (2013). Fruit and vegetable consumption and all-cause mortality: a dose-response analysis. *The American Journal of Clinical Nutrition, 98*(2), 454-459.

Beltman, S., Glass, C., Dinham, J., Chalk, B., & Nguyen, B. (2015). Drawing identity: beginning pre-service teachers' professional identities. *Issues in Educational Research, 25*(3), 225.

Bender, C. G. (2009). Changes and challenges of the service-learning movement at higher education institutions in South Africa. In M Moore & P Lan Lin (Eds.), *Service-Learning in Higher Education: Paradigms and Challenges*(pp. 295-316). Indianapolis, IN: University of Indianapolis Press.

Bender, G. (2008). Exploring conceptual models for community engagement at higher education institutions in South Africa: conversation. *Perspectives in Education, 26*(1), 81-95.

Bennett, D. (2013). The use of learner-generated drawings in the development of music students' teacher identities. *International Journal of Music Education, 31*(1), 53-67.

Berry, K. (2016). Unhealthy eating practices: identification of contributing factors amongst the youth in Shimla. *Artha-Journal of Social Sciences, 15*(4), 69-85.

Bertram, C., & Christiansen, I. M. (2013). *Understanding research: an introduction to reading research*. Pretoria: Van Schaik.

Bialik, M., Fadel, C., Trilling, B., Nilsson, P., & Groff, J. (2015). Skills for the 21st Century: what should students learn. Retrieved 17 October 2019 https://curriculumredesign.org/wp-content/uploads/CCR-Skills_FINAL_June2015.pdf

Bloomberg, L. D., & Volpe, M. (2019). *Completing your qualitative dissertation: a road map from beginning to end*. Los Angeles CA: Sage Publications.

Bourke, A. G. (2015). *Universities, community engagement, and democratic social science.* (Doctor of Philosophy), York University, Toronto, Ontario.

Boyle, A., Maguire, S., Martin, A., Milsom, C., Nash, R., Rawlinson, S., . . . Conchie, S. (2007). Fieldwork is good: the student perception and the affective domain. *Journal of Geography in Higher Education, 31*(2), 299-317.

Breuing, M. (2011). Problematizing critical pedagogy. *The International Journal of Critical Pedagogy, 3*(3).

Bringle, R. G., & Hatcher, J. A. (1996). Implementing service learning in higher education. *The Journal of Higher Education, 67*(2), 221-239.

Brookfield, S. D. (2017). *Becoming a critically reflective teacher*. San Francisco: John Wiley & Sons.

Brooks, H., Bee, P., & Rogers, A. (2018). Introduction to qualitative data analysis. In P. Bee, H. Brooks, P. Callaghan, & K. Lovell (Eds.), *A research handbook for patient and public involvement researchers*. Manchester: Manchester University Press.

Bruce-Davis, M. N., Gilson, C. M., & Matthews, M. S. (2017). Fostering authentic problem seeking: a step toward social justice engagement. *Roeper Review, 39*(4), 250. doi:10.1080/02783193.2017.1363099

Bruening, M., Argo, K., Payne-Sturges, D., & Laska, M. N. (2017). The struggle is real: a systematic review of food insecurity on postsecondary education campuses. *Journal of the Academy of Nutrition and Dietetics, 117*(11), 1767-1791.

Buchanan, R. (2015). Teacher identity and agency in an era of accountability. *Teachers and Teaching, 21*(6), 700-719.

Burbules, N. C., & Berk, R. (1999). Critical thinking and critical pedagogy: Relations, differences, and limits. In T. S. Popkewitz & L. Fendler (Eds.).*Critical theories in education: changing terrains of knowledge and politics* (pp. 45-65). New York, NY: Routledge

Burkey, S. (1993). *People first: A guide to self-reliant participatory rural development*. London: Zed Books Ltd.

Cappy, C. L. (2016). Shifting the future? Teachers as agents of social change in South African secondary schools. *Education as Change, 20*(3), 119-140.

Carey, M. A., & Asbury, J.-E. (2016). *Focus group research*. London: Routledge.

Centers for Disease Control Prevention. (2011). *Strategies to prevent obesity and other chronic diseases: the CDC guide to strategies to increase the consumption of fruits and vegetables.* Atlanta: US Department of Health and Human Services.

Chambers, D. J., & Lavery, S. (2012). Service-learning: a valuable component of pre-service teacher education. *Australian Journal of Teacher Education, 37*(4), 7.

Chaparro, M. P., Zaghloul, S. S., Holck, P., & Dobbs, J. (2009). Food insecurity prevalence among college students at the University of Hawai'i at Mānoa. *Public Health Nutrition, 12*(11), 2097-2103.

Check, J., & Schutt, R. K. (2012). *Research methods in education*. London: Sage Publications.

Chilisa, B., Major, T. E., & Khudu-Petersen, K. (2017). Community engagement with a postcolonial, African-based relational paradigm. *Qualitative Research, 17*(3), 326-339.

Christiansen, C. H. (1999). Defining lives: occupation as identity: an essay on competence, coherence, and the creation of meaning. *American Journal of Occupational Therapy, 53*(6), 547-558.

Chukwuma, C. I., Islam, M. S., & Amonsou, E. O. (2018). A comparative study on the physicochemical, anti-oxidative, anti-hyperglycemic and anti-lipidemic properties of amadumbe (Colocasia esculenta) and okra (Abelmoschus esculentus) mucilage. *Journal of Food Biochemistry, 42*(5), e12601.

Clements, T., & Bohannon, C. C. (2015). Reflections on community engagement: making meaning of experience. In K. Melcher, Be Stiefel, & K. Faurest (Eds.). Community-Built: Art, Construction, Preservation, and Place, New York, NY: Routledge.

Clemitshaw, G. (2013). Critical Pedagogy as Educational Resistance: a post-structuralist reflection. *Power and Education*, *5*(3), 268-279.

Cnaan, R. A., Smith, K. A., Holmes, K., Haski-Leventhal, D., Handy, F., & Brudney, J. L. (2010). Motivations and benefits of student volunteering: comparing regular, occasional, and non-volunteers in five countries. *Canadian Journal of Nonprofit and Social Economy Research*, *1*(1), 65-81.

Cohen, L., Manion, L., & Morrison, K. (2011). *Research methods in education* (7th ed.). London: Routledge.

Coleman-Jensen, A., Gregory, C., & Singh, A. (2014). *Household food security in the United States in 2013: Statistical Supplement*:.Washington, DC: United States Department of Agriculture.

Coleman-Jensen, A., Rabbitt, M. P., Gregory, C. A., & Singh, A. (2017). *Household food security in the United States in 2016, ERR-237* Washington, DC: United States Department of Agriculture.

Cook, J. R., & Nation, M. (2016). Community engagement: universities' roles in building communities and strengthening democracy. *Community Development, 47*(5), 718-731.

Cooper, K., & White, R. E. (2011). *Qualitative research in the post-modern era: Contexts of qualitative research*. Berlin: Springer Science & Business Media.

Council on Higher Education. (2004). *Higher Education Quality Committee: Institutional Audit Framework* Pretoria: Council on Higher Education.

Council on Higher Education. (2010). *Community engagement in South African higher education - Kagisano 6*. 2010. Pretoria: Council on Higher Education.

Council on Higher Education. (2011). *Framework for the Second Cycle of Quality Assurance 2012-2017*. Pretoria: Council on Higher Education.

Council on Higher Education. (2013). *The Aims of higher education: Kagisano 9*. Pretoria: Council on Higher Education.

Council on Higher Education. (2016a). *2013 Higher education data: participation: student racial profile*. Retrieved 12 July 2018 https://www.che.ac.za/focus_areas/higher_education_data/2013/participation.

Council on Higher Education. (2016b). *Community engagement: South African higher education reviewed, two decades of democracy*. Pretoria: Council on Higher Education.

Council on Higher Education. (2016c). *South African higher education reviewed: Two decades of democracy*. Pretoria: Council on Higher Education.

Court, D., Abbas, R., Riecken, T. J., Seymour, J. L., & Le Tran, M.-A. (2018). *Qualitative research and intercultural understanding: conducting qualitative research in multicultural settings*. New York: Routledge.

Cousin, G. (2009). *Researching learning in higher education: an introduction to contemporary methods and approaches*. New York: Routledge.

Covaleskie, J. (2003). Philosophical instruction. In D. Weil & J. Kincheloe (Eds.), *Critical thinking and learning: an encyclopedia*. Westport, CT Greenwood.

Creswell, J. W. (2012). *Educational research: planning, conducting, and evaluating quantitative and qualitative research* (4th ed.). Boston: Pearson.

Creswell, J. W. (2014). *Educational research: planning, conducting, and evaluating quantitative and qualitative research* (4th ed.). Essex: Pearson Education Limited.

Creswell, J. W., & Poth, C. N. (2018). *Qualitative inquiry and research design: Choosing among five approaches*. Los Angeles, CA: Sage publications.

Croll, J. K., Neumark-Sztainer, D., & Story, M. (2001). Healthy eating: what does it mean to adolescents? *Journal of Nutrition Education, 33*(4), 193-198.

Culver, D. M., Gilbert, W., & Sparkes, A. (2012). Qualitative research in sport psychology journals: the next decade 2000-2009 and beyond. *The Sport Psychologist, 26*(2), 261-281.

Czaykowska-Higgins, E. (2009). *Research models, community engagement, and linguistic fieldwork: reflections on working within Canadian indigenous communities.* Berlin: Mouton de Gruyter.

Danielewicz, J. (2014). *Teaching selves: identity, pedagogy, and teacher education*. New York: SUNY Press.

Darder, A., Torres, R., & Baltodano, M. (Eds.) (2017). *The critical pedagogy reader* (3rd ed.). New York: Routledge.

Davidson, A., & Morrell, J. (2018). Food insecurity prevalence among university students in New Hampshire. *Journal of Hunger & Environmental Nutrition*, 1-10.

De Beer, J., & Petersen, N. (2016). Decolonisation of the science curriculum: A different perspective (# Cookbook-Labs-Must-Fall). Proceedings: *Towards Effective Teaching and Meaningful Learning in Mathematics, Science and Technology.* ISTE International Conference on Mathematics, Science and Technology Education 23-28 October 2016. Mopani Camp in Kruger National Park, Limpopo, South Africa.

de Leon-Carillo, C. (2007). Filipino pre-service education students' preconceptions of teacher roles viewed through a metaphorical lens. *Asia-Pacific Journal of Teacher Education, 35*(2), 197-217.

Deliens, T., Clarys, P., De Bourdeaudhuij, I., & Deforche, B. (2014). Determinants of eating behaviour in university students: a qualitative study using focus group discussions. *BMC public health*, *14*(1), 53.

De Rassenfosse, G., & Williams, R. (2015). Rules of engagement: measuring connectivity in national systems of higher education. *Higher Education, 70*(6), 941-956.

De Villiers, M. (2019). Create a vertical hydroponic garden. *SABI Magazine-Tydskrif, 11*(3), 26-28.

Degener, S. C. (2001). Making sense of critical pedagogy in adult literacy education. *Annual Review of Adult Learning and Literacy, 2*(1), 26-62.

Dempsey, S. E. (2010). Critiquing community engagement. *Management Communication Quarterly, 24*(3), 359-390.

Department of Basic Education. (2011). *National Curriculum Statement (NCS): Curriculum and Assessment Policy Statement; Further and Education Training Phase Grades 10-12 Life Sciences*. Pretoria: Government Printer.

Department of Basic Education. (2017). Select Committee on Education and Recreation - Poverty Ranking of Schools (Quantiles). Retrieved 15 October 2019 https://slideplayer.com/slide/14842425/

Department of Education. (2001). *National Plan for Higher Education*. Pretoria: Government Printer.

Department of Higher Education and Training. (2013). Statistics on post-school education and training in South Africa: 2013. Retrieved 28 August 2019 http://www.dhet.gov.za/DHET%20Statistics%20Publication/Statistics%20on%20Post-School%20Education%20and%20Training%20in%20South%20Africa%202013.pdf

Department of Higher Education and Training. (2015). *Revised Policy on the Minimum requirements for Teacher Education Qualifications*. Pretoria: Government Printer.

Devereux, S. (2018). South Africa's university students face a crisis: nearly a third go hungry. Retrieved 15 October 2019 https://foodsecurity.ac.za/news/south-africas-university-students-face-a-crisis-nearly-a-third-go-hungry/

Dewey, J. (1916). Democracy and education. Retrieved 27 January 2019 https://en.wikisource.org/wiki/Democracy_and_Education

Dewey, J. (1938). Experience and education. Retrieved 14 December 2018 https://archive.org/details/ExperienceAndEducation

Diwu, C., Ogunniyi, M. B., & Langenhoven, K. R. (2011, January). Effects of a Dialogical Argumentation Instructional Model (DAIM) on grade 10 learners' conceptions of fermentation. In *Proceedings of the Nineteenth Annual*

Meeting of the Southern African Association for Research in Mathematics, Science and Technology Education,SAARMSTE (pp. 355-365).

Domfeh, K. A. (2007). Indigenous knowledge systems and the need for policy and institutional reforms. *Tribes and Tribals, 1*, 41-52.

Dominguez-Whitehead, Y. (2015). Students' food acquisition struggles in the context of South Africa: the fundamentals of student development. *Journal of College Student Development, 56*(3), 292-308.

Doody, O., & Doody, C. M. (2015). Conducting a pilot study: case study of a novice researcher. *British Journal of Nursing, 24*(21), 1074-1078.

Dooly, M., Moore, E., & Vallejo, C. (2017). *Research ethics.* La Grange des Noyes, France: Research-publishing.net.

Doygun, O., & Gulec, S. (2012). The problems faced by university students and proposals for solution. *Procedia-Social and Behavioral Sciences, 47*, 1115-1123.

Drew, C. J., Hardman, M. L., & Hosp, J. L. (2008). *Designing and conducting research in education*. Los Angeles, CA: Sage Publications.

Drinkwater, M. A. (2014). *Democratizing and decolonizing education: a role for the arts and cultural praxis: lessons from primary schools in Maasailand, southern Kenya.* (Doctor of Philosophy) University of Toronto, Toronto, Canada

Driscoll, A. (2008). Carnegie's community-engagement classification: intentions and insights. *Change: The Magazine of Higher Learning, 40*(1), 38-41.

Duram, L. A., & Klein, S. K. (2015). University food gardens: a unifying place for higher education sustainability. *International Journal of Innovation and Sustainable Development, 9*(3/4).

Elaati, A. A. N. (2016). Postmodernism Theory: Presentation, University Putra Malaysia. Evans, JC (2018).

Elango, S., Jutti, R., & Lee, L. (2005). Portfolio as a learning tool: students' perspective. *Annals - Academy of Medicine Singapore, 34*(8), 511.

Entz, M., Slater, J., & Desmarais, A. A. (2017). Student food insecurity at the University of Manitoba. *Canadian Food Studies/La Revue canadienne des études sur l'alimentation, 4*(1), 139-159.

Erginel, S. Ş. (2006). *Developing reflective teachers: a study on perception and improvement of reflection in pre-service teacher education* (Doctor of Philosophy). Middle East Technical University, Ankara, Turkey.

Espey, M. (2018). Diversity, effort, and cooperation in team-based learning. *The Journal of Economic Education, 49*(1), 8-21.

Falk, A. (2012). Enhancing the team experience in service learning courses. *Journal for Civic Commitment, 18*, 1.

Farinde-Wu, A., Glover, C. P., & Williams, N. N. (2017). It's not hard work; it's heart work: strategies of effective, award-winning culturally responsive teachers. *The Urban Review, 49*(2), 279-299.

Farner, K. (2019). Institutionalizing Community Engagement in Higher Education: A Case Study of Processes Toward Engagement. *Journal of Higher Education Outreach and Engagement*, *23*(2), 147-152.

Fataar, A. (2018). Decolonising education in South Africa: perspectives and debates. *Educational Research for Social Change, 7*(SPE), vi-ix.

Fernandez-Docallas, F. (2016). Teachers as transformative intellectuals by Henry Giroux. Retrieved 8 July 2018 https://www.slideshare.net/lynfroi/teachers-as-transformative-intellectuals-by-henry-giroux

Ferrigno, J., Hemphill, D., & Lee, M.-y. (2005). Teaching for empowerment liberatory pedagogy, social change and gender dynamics. *Proceedings of the Adult Education Research Conference.* Athens, GA: University of Georgia.

Fitzgerald, H. E., Bruns, K., Sonka, S. T., Furco, A., & Swanson, L. (2016). The centrality of engagement in higher education. *Journal of Higher Education Outreach and Engagement, 20*(1), 223-244.

Flick, U. (2014). *An introduction to qualitative research*. London: Sage Publication Limited.

Flick, U. (2018). *An introduction to qualitative research.* Los Angeles, CA: Sage Publications Limited.

Flynn, M. (2017). From answer-getters to problem solvers: three-act tasks foster deeper thinking and greater engagement in math class. *Educational Leadership, 75*(2), 26.

Fobes, C., & Kaufman, P. (2008). Critical pedagogy in the sociology classroom: Challenges and concerns. *Teaching Sociology*, *36*(1), 26-33.

Fonchingong, C. C., & Fonjong, L. N. (2003). The concept of self-reliance in community development initiatives in the Cameroon grassfields. *Nordic Journal of African Studies, 12*(2), 196-219.

Food and Agriculture Organization. (2004). The state of food insecurity in the world 2004: monitoring progress towards the World Food Summit and Millennium Development Goals Rome. Retrieved 31 July 2019 http://www.fao.org/3/y5650e/y5650e00.pdf

Fortney, L. (2011). Critical pedagogy. Retrieved 9 July 2018 https://sites.google.com/a/nau.edu/learning-theories-etc547-spring-2011/theory/critical-pedagogy

Fountain, J., Patel, K., & Buffin, J. (2007). *Community engagement: the centre for ethnicity and health model*. Amsterdam: Foundation RegenboogAMOC.

Freire, P. (1970). *Pedagogy of the oppressed*. New York, NY: Bloomsbury Academic.

Freire, P. (1973). *Education for critical consciousness* (Vol. 1) New York, NY: Bloomsbury Publishing.

Freire, P. (1993). *Pedagogy of the oppressed.* New York: Continuum International.

Freire, P. (2000). *Pedagogy of freedom: ethics, democracy, and civic courage*. Lanham, MD: Rowman & Littlefield.

Friesen, M. D., & Besley, S. C. (2013). Teacher identity development in the first year of teacher education: a developmental and social psychological perspective. *Teaching and Teacher Education, 36*, 23-32.

Frymer, B. (2005). Freire, alienation, and contemporary youth: toward a pedagogy of everyday life. *InterActions: UCLA Journal of Education and Information Studies, 1*(2).

Fuchs, C. (2016). Critical theory. *The International Encyclopedia of Communication Theory and Philosophy* (1-20).Hoboken, NJ: Wiley.

Fusch, P., Fusch, G. E., & Ness, L. R. (2018). Denzin's paradigm shift: revisiting triangulation in qualitative research. *Journal of Social Change, 10*(1), 2.

Gencel, I. E., & Saracaloglu, A. S. (2018). The effect of layered curriculum on reflective thinking and on self-directed learning readiness of prospective teachers. *International Journal of Progressive Education, 14*(1), 8-20.

Gibbons, M. (2006). *Engagement as a core value in a mode 2 society.* Paper presented at the Keynote address at CHE-HEQC/JET-CHESP Conference on community engagement in Higher Education.

Giroux, H. (1983). *Theory and resistance in education: a pedagogy for the opposition*. London: Heinemann Educational Books Ltd.

Giroux, H. (1984). *Ideology, culture, and the process of schooling*. Philadelphia: Temple University Press.

Giroux, H. (1997). *Pedagogy and the politics of hope: theory, culture, and schooling. a critical reader*. Boulder, CO: West View Press.

Giroux, H. (2004). Critical pedagogy and the postmodern/modern divide: towards a pedagogy of democratization. *Teacher Education Quarterly, 31*(1), 31-47.

Giroux, H. (2010). Lessons from Paulo Freire. Retrieved 15 June 2018 http://appalachiafilm.org/images/neh/Giroux,_H._-Lessons_From_Paulo_Freire_.pdf

Giroux, H. (2011). *On critical pedagogy*. New York: Bloomsbury.

Giroux, H. A. (2008). Education and the crisis of youth: schooling and the promise of democracy. *The Educational Forum,* 73(1), 8-18.

Giroux, H. (2013a). The spectacle of Illiteracy and the crisis of democracy. Retrieved 11 February 2019 https://truthout.org/articles/henry-giroux-the-spectacle-of-illiteracy-and-the-crisis-of-democracy/

Giroux, H. A. (2013b). Angela Davis, freedom and the politics of higher education. Retrieved 20 September 2018 https://www.scribd.com/document/150869739/Henry-Giroux-Essays

Giroux, H. A. (2018). When schools become dead zones of the imagination: a critical pedagogy manifesto. *The Wiley Handbook of Global Educational Reform*, (pp. 503-515).Hoboken, NJ: Wiley.

Gitau, G. N., Kimiywe, J. O., Waudo, J. N., Mwoma, T., Pillay, J., Muthee, M., . . . Nthukah, M. M. (2016). quality nutrition education and its impact on

haemoglobin levels of school pupils of Muranga County, Kenya. *International Journal of Advanced Nutritional and Health Science*, 4 Feb.

Gitt, A. K., Lautsch, D., Ferrieres, J., Kastelein, J., Drexel, H., Horack, M., . . . Chazelle, F. (2016). Low-density lipoprotein cholesterol in a global cohort of 57,885 statin-treated patients. *Atherosclerosis, 255*, 200-209.

Goddard, J. (2011). Connecting Universities to regional growth: a practical guide, Brussels. European Union.Retrieved May, 10, 2013 http://ec.europa.eu/regional_policy/sources/docgener/presenta/universities2011/universities2011_en.pdf.

Goldrick-Rab, S., Richardson, J., Schneider, J., Hernandez, A., & Cady, C. (2018). *Still hungry and homeless in college*: Wisconsin WI: HOPE Lab Madison.

Govender, N. (2012). Educational implications of applying the complexity approach to Indigenous Knowledge Systems (IKS). *Alternation, 19*(2), 112-137.

Govender, N. (2014). Re-envisioning pedagogy for African Higher Education: Students' status of science and IKS via argumentation discourses. *Alternation*, *12*, 358-384.

Govender, N., Mudaly, R., & James, A. (2016). Engaging indigenous knowledge holders in teaching preservice teachers in IKS food production and practices: implications for higher education. *Alternation, 23*(1), 180-207.

Gramsci, A. (1970). Schools and education. *Australian Left Review, 1*(26), 71-79.

Gresse, A., Pietersen, J., & Steenkamp, L. (2015). The influence of student accommodation on NMMU students' dietary patterns, activity and alcohol consumption. *South African Journal of Higher Education, 29*(6), 93-105.

Gruenewald, D. A. (2003). The best of both worlds: a critical pedagogy of place. *Educational Researcher, 32*(4), 3-12.

Gu, M., & Benson, P. (2015). The formation of English teacher identities: a cross-cultural investigation. *Language Teaching Research, 19*(2), 187-206.

Guchait, P., Lei, P., & Tews, M. J. (2016). Making teamwork work: team knowledge for team effectiveness. *The Journal of psychology, 150*(3), 300-317.

Guion, L. (2002). Triangulation: establishing the validity of qualitative studies. Retrieved 17 September 2019. https://sites.duke.edu/niou/files/2014/07/W13-Guion-2002-Triangulation-Establishing-the-Validity-of-Qualitative-Research.pdf

Gwacela, M. (2013). *Exploring food insecurity and socio-economic factors affecting academic performance: a case study of first year students on probation and at-risk of academic exclusion* (Master of Science). University of KwaZulu-Natal, Pietermaritzburg.

Hall, K., & Giese, S. (2009). Addressing quality through school fees and school funding. In S. Pendlebury, L. Lake, & C. Smith (Eds.), *South African child gauge 2008/2009* (pp. 34-40). Cape Town: Children's Institute, UCT.

Hall, M. (2010). Community engagement in South African higher education *Community Engagement in South African Higher Education - Kagisano 6*. Auckland Park: Jacana Media (Pty).

Hammersley, M., & Traianou, A. (2012). *Ethics in qualitative research: controversies and contexts*. London: Sage.

Harrison, B., Nelson, C., & Stroink, M. (2013). Being in Community: A Food Security Themed Approach to Public Scholarship. *Journal of Public Scholarship in Higher Education*, *3*, 91-110.

Hebert, A., & Hauf, P. (2015). Student learning through service-learning: effects on academic development, civic responsibility, interpersonal skills, and practical skills. *Active Learning in Higher Education, 16*(1), 37-49.

Hesse-Biber, S. N., & Leavy, P. (2011). *The practice of qualitative research* (2nd ed.). California: Sage.

Hewson, M. G., & Ogunniyi, M. B. (2011). Argumentation-teaching as a method to introduce indigenous knowledge into science classrooms: opportunities and challenges. *Cultural Studies of Science Education, 6*(3), 679-692.

Higher Education Authority. (2017). Report on student accommodation: demand and supply. Retrieved 02 October 2019 https://hea.ie/assets/uploads/2017/06/Report-on-Student-Accommodation-Demand-Supply.pdf

Higher Education Quality Committee. (2006). *A good practice guide and self-evaluation instruments for managing the quality of service-learning*. Pretoria: Council on Higher Education.

Higher Education Quality Committee. (2007). *Community engagement in higher education: proceedings of the conference*. Pretoria: Council on Higher Education. Retrieved 19 June 2018 https://www.che.ac.za/sites/default/files/publications/HEQC_Conference_Community_Engagement_HE_2007.pdf.

Hillery, G. J. A. (1955). Definitions of community: areas of agreement. *Rural Sociology, 20*(118), 118.

Hoare, Q., & Nowell-Smith, G. (2005). *Selections from prison notebooks*. London: Lawrence & Wishart.

Holland, B. A. (2005). Reflections on community-campus partnerships: what has been learned? What are the next challenges. In P. A. Pasque, R. E. Smerek, B. Dwyer, N. Bowman, & B. L. Mallory (Eds.). *Higher education collaboratives for community engagement and improvement* (pp. 10-17). Ann Arbor, MI; National Forum on Higher Education for the Public Good.

Holt, M., & Powell, S. (2017). Healthy Universities: a guiding framework for universities to examine the distinctive health needs of its own student population. *Perspectives in Public Health, 137*(1), 53-58.

Hughes, R., Serebryanikova, I., Donaldson, K., & Leveritt, M. (2011). Student food insecurity: the skeleton in the university closet. *Nutrition & Dietetics, 68*(1), 27-32.

IFRC. (2013). International Federation of Red Cross and Red Crescent Societies: Nutrition Guidelines. Retrieved 04 November 2019 file:///C:/Users/User/Desktop/First%20Draft%20October/Red%20Cross%20ifrc-nutrition-guidelines.pdf

Izadinia, M. (2013). A review of research on student teachers' professional identity. *British Educational Research Journal, 39*(4), 694-713.

Jacob, W. J., Sutin, S. E., Weidman, J. C., & Yeager, J. L. (2015). *Community engagement in higher education: policy reforms and practice*. Berlin: Springer.

Jacobs, K. R. (2015). *The classroom implementation of indigenous knowledge in the science curriculum by science teachers in the Western Cape province, South Africa* (Doctor of Philosophy) University of Cape Town, Cape Town.

Jain, R., & Janakiram, T. (2016). *Vertical gardening: a new concept of modern era. commercial horticulture.* New Delhi, India: New India Publishing Agency.

James, A. (2010). Pre-service student teacher professional development: research and service-learning. *Problems of Education in the 21st Century, 26*, 67-70.

Jameson, F. (1974). *Marxism and form: twentieth-century dialectical theories of literature* (Vol. 312) Princeton, NJ: Princeton University Press.

Janesick, V. J. (1994). The dance of qualitative research design: metaphor, methodolatry, and meaning. *Handbook of Qualitative Research*. Thousand Oaks, CA: Sage.

Jansen, J. (2018). The future prospects of South African universities. Retrieved 08 May 2017 https://www.africaportal.org/publications/future-prospects-south-african-universities/

Johnson, J. L., Adkins, D., & Chauvin, S. (2019). Quality indicators of rigor in qualitative research. *American Journal of Pharmaceutical Education*, ajpe7120.

Karaolis, A., & Philippou, G. N. (2019). Teachers' professional identity. In M. Hannula, G. Leder, F. Morselli, M. Vollstedt, Q. Zhang (Eds.). Affect and Mathematics Education. *Affect and mathematics education* (pp. 397-417). Berlin: Springer.

Karwat, D., Sherman, L. S., Cole, L., Badiane, K. C., Coseo, P. J., & Larsen, L. S. (2013). A lesson in service learning and community engagement. *Michigan Journal of Sustainability, 1*.

Kassier, S., & Veldman, F. (2013). Food security status and academic performance of students on financial aid: the case of University of KwaZulu-Natal. *Alternation, 9*, 248-264.

Kasun, G. S., & Saavedra, C. M. (2016). Disrupting ELL teacher candidates' identities: indigenizing teacher education in one study abroad program. *TESOL Quarterly, 50*(3), 684-707.

Kearney, J. (2015). Challenges for community engagement: an Australian perspective. *Educational Research for Social Change, 4*(1), 26-39.

Keesing-Styles, L. (2003). The relationship between critical pedagogy and assessment in teacher education. *Radical Pedagogy, 5*(1).

Kellner, D. (2019). Toward a critical theory of society. In Y. Stravrakakis (Ed.), *Routledge handbook of psychoanalytic political theory* London: Routledge.

Khupe, C. (2014). *Indigenous knowledge and school science: possibilities for integration* (Doctor of Philosophy). University of the Witwatersrand,Johannesburg.

Kincheloe, J. L. (2008a). *Critical pedagogy primer*. New York: Peter Lang.

Kincheloe, J. L. (2008b). *A call to action: an introduction to education, philosophy, and Native North America*. Chapter: The past, present, and future of critical pedagogy, with Joe Kincheloe (153-162). New York: Peter Lang

Kincheloe, J. L., & McLaren, P. (2011). Rethinking critical theory and qualitative research. In: Hayes K., Steinberg S. R., & Tobin K. (Eds.). *Key works in critical pedagogy. Bold visions in educational research*, vol 32. Rotterdam: SensePublishers

Kincheloe, J. L., & Semali, L. (1999). *What is indigenous knowledge? Voices from the academy*. New York, NY: Falmer Press.

Klemenčič, M., Luescher, T. M., & Jowi, J. O. (2015). Student power in Africa. *Journal of Student Affairs in Africa, 3*(1).

Klevesath, L., & Reese-Schäfer, W. (2016). The ambiguous meaning of community. In A. Besussi (Ed.), *A companion to political philosophy: methods, tools, topics*. London: Routledge

Klug, E., Raal, F., Marais, A., Smuts, C., Schamroth, C., Jankelow, D., . . . Webb, D. (2018). South African dyslipidaemia guideline consensus statement: 2018 update A joint statement from the South African Heart Association (SA Heart) and the Lipid and Atherosclerosis Society of Southern Africa (LASSA). *South African Medical Journal, 108*(11b), 973-1000.

Koopman, O. (2018). Towards decolonising teaching strategies: how to'domesticate'and'infuse'Western science with indigenous knowledge. *Journal of Education 74*, 102-115.

Krause, K. (2005). *Understanding and promoting student engagement in university learning communities.* Paper presented as keynote address: Engaged, Inert or Otherwise Occupied, James Cook University, Townsville, Australia.

Krause, K., & Croates, H. (2008). Students' engagement in first-year university. *Assessment & Evaluation in Higher Education, 33*(5), 493-505.

Kumar, R. (2014). *Research methodology: a step-by-step guide for beginners*. Los Angeles, CA: Sage Publications Limited.

Kumar, R. (2019). *Research methodology: a step-by-step guide for beginners.* Los Angeles, CA: Sage Publications Limited.

Kvale, S., & Brinkmann, S. (2009). *Interviews: learning the craft of qualitative research interviewing* (2nd ed.). Los Angeles, CA: Sage.

Kypri, K., Paschall, M. J., Langley, J. D., Baxter, J., & Bourdeau, B. (2010). The role of drinking locations in university student drinking: Findings from a national web-based survey. *Drug and Alcohol Dependence*, *111*(1-2), 38-43.

Labadarios, D., Mchiza, Z., Steyn, N., Gericke, G., Maunder, E., Davids, Y., & Parker, W. (2011). Food insecurity in South Africa: a review of national surveys. Bulletin of the World Health Organisation, 89: 891-899. Retrieved 31 July 2019 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3260897/

Langer, E. J. (2000). Mindful learning. *Current Directions in Psychological Science, 9*(6), 220-223.

Lankshear, C., McLaren, P. L., & McLaren, P. (1993). *Critical literacy: politics, praxis, and the postmodern.* New York, NY: SUNY Press.

Laraia, B. A. (2013). Food insecurity and chronic disease. *Advances in Nutrition, 4*(2), 203-212.

Larios-Sanz, M., Simmons, A. D., Bagnall, R. A., & Rosell, R. C. (2011). Implementation of a service-learning module in medical microbiology and cell biology classes at an undergraduate liberal arts university. *Journal of Microbiology & Biology Education: JMBE*, *12*(1), 29.

Lavery, S., Coffey, A., & Sandri, S. (2017). The value of service-learning in a pre-service secondary teacher qualification service-learning: enhancing inclusive education. In S. Forlin (Ed). *International Perspectives on Inclusive Education* (pp. 241-263). Bingley, UK: Emerald Publishing Limited.

Le Clus, M. (2012). Tracking and measuring engagement: a review of the literature. *Australasian Journal of University-Community Engagemen*t, *7*(1), 21–44.

Le Grange, L. (2016). Decolonising the university curriculum: leading article. *South African Journal of Higher Education, 30*(2), 1-12.

Lee, S. D., Hanbazaza, M., Ball, G. D., Farmer, A., Maximova, K., & Willows, N. D. (2018). Food insecurity among postsecondary students in developed countries: a narrative review. *British Food Journal, 120*(11), 2660-2680.

Leisey, M., Holton, V., & Davey, T. L. (2012). Community engagement grants: assessing the impact of university funding and engagements. *Journal of Community Engagement and Scholarship, 5*(2), 41-47.

Lewin, T., & Mawoyo, M. (2014). *Student access and success: issues and interventions in South African universities*. Cape Town: Inyathelo.

Liamputtong, P. (2011). *Focus group methodology: principles and practice*. Los Angeles, CA: Sage.

Lichtman, M. (2010). *Qualitative research in education: a user's guide*. Los Angeles, CA: Sage.

Liu, C., Xie, B., Chou, C. P., Koprowski, C., Zhou, D., Palmer, P., ... & Johnson, C. A. (2007). Perceived stress, depression and food consumption frequency in

the college students of China Seven Cities. *Physiology & behavior*, *92*(4), 748-754.

Lotz-Sisitka, H., Wals, A. E., Kronlid, D., & McGarry, D. (2015). Transformative, transgressive social learning: rethinking higher education pedagogy in times of systemic global dysfunction. *Current Opinion in Environmental Sustainability, 16*, 73-80.

Lourens, A., & Bleazard, D. (2016). Applying predictive analytics in identifying students at risk: a case study. *South African Journal of Higher Education, 30*(2), 129-142.

Mahmoudi, A., Khoshnood, A., & Babaei, A. (2014). Paulo Freire's critical pedagogy and its implications in curriculum planning. *Journal of Education and Practice, 5*(14), 86-91.

Maistry, M., & Thakrar, J. (2012). Educating students for effective community engagement: student perspectives on curriculum imperatives for universities in South Africa. *South African Review of Sociology, 43*(2), 58-75.

Maitra, C. (2018). *A review of studies examining the link between food insecurity and malnutrition. Technical Paper*. Retrieved 02 February 2019 http://www.fao.org/3/CA1447EN/ca1447en.pdf

Majid, M. A. A., Othman, M., Mohamad, S. F., Lim, S. A. H., & Yusof, A. (2017). Piloting for interviews in qualitative research: operationalization and lessons learnt. *International Journal of Academic Research in Business and Social Sciences, 7*(4), 1073-1080.

Major, T., & Thalia, M. (2018). Problem-based learning pedagogies in teacher education: the case of Botswana. *Interdisciplinary Journal of Problem-Based Learning, 12*(1), 1.

Major, T. E. (2014). Paulo Freire's education for freedom: implications for teaching-learning process in Botswana. *National Teacher Education Journal, 7*(1).

Malan, N., Campbell, A. D., Sibeko, J., van Zyl, C., & Benecke, R. (2015). Service learning for food security: The Izindaba Zokudla experience. Retrieved 16 November 2019 https://www.academia.edu/16813228/Service_Learning_for_Food_Security_The_Izindaba_Zokudla_Experience?auto=download

Mandal, P. C. (2018). Qualitative research: criteria of evaluation. *Qualitative Research, 3*(2), 1-6.

Marcuse, H. (1989). Philosophy and critical theory. In S. E. Bronner & D. M. Kellner (Eds.), *Critical theory and society: a reader*. New York: Routledge.

Maringe, F., & Sing, N. (2014). Theorising research with vulnerable people in higher education: ethical and methodological challenges. *South African Journal of Higher Education, 28*(2), 533-549.

Marinova, D., & Hossain, A. (2006). *Principles for self-reliance and sustainability: case study of Bangladesh.* Paper presented at the Proceedings of the Anti-Poverty Academic Conference with International Participation, Institute for Sustainability and Technology Policy, Murdoch University, Perth.

Marshall, C., & Rossman, G. B. (2011). *Designing qualitative research* (5th ed.). Los Angeles: Sage publications.

Martinez, S. M., Frongillo, E. A., Leung, C., & Ritchie, L. (2018). No food for thought: food insecurity is related to poor mental health and lower academic performance among students in California's public university system. *Journal of Health Psychology*, June 2018.

Maurial, M. (1999). Indigenous knowledge and schooling: a continuum between conflict and dialogue. In L. M. Semali,& J. L. Kincheloe (Eds.), *What is indigenous knowledge* (pp. 59-77). New York, NY: Falmer Press.

Mayer, D. (1999). *Building teaching identities: implications for preservice teacher education.* Paper presented at the Australian Association for Research in Education Conference, Melbourne.

McCarthy, T. (1994). *On the idea of a critical theory and its relations to philosophy*. In D. C. Hoy & T. McCarthy (Eds.), *Critical theory*. Oxford: Blackwell.

McKenna, S. (2013). *Introduction in the aims of higher education, Kagisano number 9*. Pretoria: Council on Higher Education.

McMillan, J., & Schumacher, S. (2014). *Research in education: evidence-based inquiry* (7th ed.). Edinburgh Gate: Pearson.

MedlinePlus. (2019). LDL: The "bad" cholesterol. Retrieved 2 September 2019 https://medlineplus.gov/ldlthebadcholesterol.html

Merriam, S. B. (2009). *Qualitative research: a guide to design and implementation*. San Fransciso: Jossey-Bass.

Merriam, S. B., & Tisdell, E. J. (2016). *Qualitative research: a guide to design and implementation* (4th ed.). San Francisco: John Wiley & Sons.

Michael, R., Florian, K., Evans, M., Anri, M., Moira, B., & Nicolette, R. (2018). Food insecurity and coping strategies amongst students at University of Witwatersrand. *Journal of Food Security, 6*(1), 20-25.

Miller, G. (2013). Education for citizenship: community engagement between the Global South and the Global North. *Journal of Geography in Higher Education, 37*(1), 44-58.

Mills, J., Harrison, H., Franklin, R., & Birks, M. (2017). Case study research: Foundations and methodological orientations. *Forum Qualitative Sozialforschung/Forum: Qualitative Social Research 18*(1), Art. 19.

Montag, C., Błaszkiewicz, K., Sariyska, R., Lachmann, B., Andone, I., Trendafilov, B., . . . Markowetz, A. (2015). Smartphone usage in the 21st century: who is active on WhatsApp? *BMC Research Notes, 8*(1), 331.

Morris, N. M. (2015). *Foundation education in the New Zealand tertiary sector: towards a conceptual framework for foundation learning provision and policy directions* (Doctor of Philosophy). Curtin University, Perth, Australia.

Mouton, J., & Wildschut, L. (2005). Service learning in South Africa: lessons learnt through systematic evaluation. *Acta Academica, 2005*(Supplement 3), 116-150.

Mtawa, N. N., Fongwa, S. N., & Wangenge-Ouma, G. (2016). The scholarship of university-community engagement: interrogating Boyer's model. *International Journal of Educational Development, 49*, 126-133.

Mudaly, R. (2018). Towards decolonising a module in the pre-service science teacher education curriculum: the role of indigenous knowledge systems in creating spaces for transforming the curriculum. *Journal of Education 74*, 47-66.

Mudaly, R., & Ismail, R. (2013). Teacher learning through tapping into indigenous knowledge systems in the science classroom. *Alternation, 20*(1), 178-202.

Mukoni, M., Mudaly, R., & Moletsane, R. (2018). Gender, power and women's participation in community environmental education. *Southern African Journal of Environmental Education, 34*.

Munro, N., Quayle, M., Simpson, H., & Barnsley, S. (2013). Hunger for knowledge: Food insecurity among students at the University of KwaZulu-Natal. *Perspectives in Education, 31*(4), 168-179.

Na, M., Miller, M., Ballard, T., Mitchell, D. C., Hung, Y. W., & Melgar-Quiñonez, H. (2019). Does social support modify the relationship between food insecurity

and poor mental health? Evidence from thirty-nine sub-Saharan African countries. *Public Health Nutrition, 22*(5), 874-881.

Naidoo, P. D. (2010). *Teachers' interpretation and implementation of the policy on indigenous knowledge in the science national curriculum statement* (Doctor of Philosophy). University of KwaZulu-Natal, Durban.

Naidoo, P. D., & Vithal, R. (2014). Teacher approaches to introducing indigenous knowledge in school science classrooms. *African Journal of Research in Mathematics, Science and Technology Education, 18*(3), 253-263.

Nasir, N. F. M., Salamat, M., Ghani, F. A., & Redzuan, N. I. N. (2017). Addressing challenges via university-community engagement activities among international undergraduate students of private university: a case study. *International Journal of Education, 2*(5), 206-214.

Nath, S. (2014). The concept of reality from postmodern perspectives. *Journal of Business Management & Social Sciences Research, 3*(5), 26-30.

National Planning Commission. (2012). *National Development Plan 2030: Our Future - Make it work*. Pretoria: Government Printers.

National Research Foundation. (2014). *Community engagement funding instrument knowledge fields development framework document*. Pretoria: Government Printer.

Nazmi, A., Martinez, S., Byrd, A., Robinson, D., Bianco, S., Maguire, J., . . . Ritchie, L. (2018). A systematic review of food insecurity among US students in higher education. *Journal of Hunger & Environmental Nutrition*, 1-16.

Ndhlala, A. R., Ncube, B., Abdelgadir, H. A., Du Plooy, C. P., & Van Staden, J. (2017). Antioxidant potential of african medicinal plants. In Al-Gubory, K.H. & Laher, I. (Eds). *Nutritional antioxidant therapies: treatments and perspectives* (pp. 65-88). Berlin: Springer.

Network, T. (2005). *Strengthening the civic roles and social responsibilities of higher education.* Paper presented at the Report of the 2005 Talloires Conference 2005. September 15-17. Tufts University European Center Talloires, France.

Ngumbi, E. N. (2017). Africa needs its own version of the vertical farm to feed growing cities. Retrieved 22 August 2019 https://theconversation.com/africa-needs-its-own-version-of-the-vertical-farm-to-feed-growing-cities-74929

Nieuwenhuis, J. (2016). Qualitative research designs and data-gathering techniques. In K. Maree (Ed.), *First steps in research* (2nd ed.). Pretoria: Van Schaik.

Nikolakaki, M. (2012). Critical pedagogy in the new Dark Ages. In M. Nikolakaki (Ed.), *Critical pedagogy in the new Dark Ages: challenges and possibilities*. New York: Peter Lang.

Nkoana, E., & Dichaba, M. (2017). Development and application of conceptual and analytic frameworks for community engagement at a South African higher education institution. *South African Journal of Higher Education, 31*(6), 177-196.

Nnadozie, E. (2018). Fulfilling education's promise in Africa: the role of the university. Retrieved 26 July 2019 https://www.funai.edu.ng/wp-content/uploads/2016/11/Lecture-on-Fulfilling-Education-Promise-in-Africa-Final-21-Nov.pdf

Nordling, L. (2018). How decolonization could reshape South African science. *Nature, 554*(7691).

North West University. (2016). Community engagement policy. Retrieved 08 December 2018 http://www.nwu.ac.za/sites/www.nwu.ac.za/files/files/i-governance-management/policy/10P-10.4_Community%20Engagement%20Policy_eng.pdf

O'Meara, K., Sandmann, L. R., Saltmarsh, J., & Giles, D. E. (2011). Studying the professional lives and work of faculty involved in community engagement. *Innovative Higher Education, 36*(2), 83-96.

Ogbonnaya, U. I., & Awuah, F. K. (2019). Quantile ranking of schools in South Africa and learners' achievement in probability. *Statistics Education Research Journal, 18*(1), 106-119.

Ogunniyi, M. (2007). Teachers' stances and practical arguments regarding a science-indigenous knowledge curriculum: Part 1. *International Journal of Science Education, 29*(8), 963-986.

Oliver-Hoyo, M., & Allen, D. (2006). The use of triangulation methods in qualitative educational research. *Journal of College Science Teaching, 35*(4).

Olsen, B. (2008). How reasons for entry into the profession illuminate teacher identity development. *Teacher education quarterly, 35*(3), 23-40.

Olsen, B. (2011). I am large, I contain multitudes. Teacher identity as a useful frame for research, practice, and diversity in teacher education. In A. F. Ball & C. A. Tyson (Eds.), *Studying diversity in teacher education* (pp. 257-273). Lanham, MD: Rowman & Littlefield.

Ontario Ministry of Training Colleges and Universities. (2009). Essential employability skills: Ontario Ministry of Training Colleges and Universities. Retrieved 19 January 2019 http://www.tcu.gov.on.ca/pepg/audiences/colleges/progstan/essential.html

Onwuemele, A. (2018). University-community engagement in Nigeria: evidence from selected universities. *Mediterranean Journal of Social Sciences, 9*(5), 29-39.

Oswald, M., & Perold, M. (2015). A teacher's identity trajectory within a context of change. *South African Journal of Education, 35*(1).

Pan, L., Sherry, B., Njai, R., & Blanck, H. M. (2012). Food insecurity is associated with obesity among US adults in 12 states. *Journal of the Academy of Nutrition and Dietetics, 112*(9), 1403-1409.

Paphitis, S. A., & Kelland, L. (2016). The university as a site for transformation: developing civic-minded graduates at South African institutions through an epistemic shift in institutional culture. *Education as Change, 20*(2), 184-203.

Papier, K., Ahmed, F., Lee, P., & Wiseman, J. (2015). Stress and dietary behaviour among first-year university students in Australia: sex differences. *Nutrition*, *31*(2), 324-330.

Patil, R. R., & Navghare, A. A. (2019). Medicinal plants for treatment of anaemia: a brief review. *World Journal of Pharmaceutical Research, 8*(5), 701-717.

Patton-López, M. M., López-Cevallos, D. F., Cancel-Tirado, D. I., & Vazquez, L. (2014). Prevalence and correlates of food insecurity among students attending a midsize rural university in Oregon. *Journal of Nutrition Education and Behavior, 46*(3), 209-214.

Patton, M. Q. (2015). *Qualitative evaluation and research methods* (4th ed.). Thousand Oaks, CA: SAGE

Peltzer, K., Pengpid, S., Samuels, T., Özcan, N., Mantilla, C., Rahamefy, O., . . . Gasparishvili, A. (2014). Prevalence of overweight/obesity and its associated factors among university students from 22 countries. *International Journal of Environmental Research and Public Health, 11*(7), 7425-7441.

PennState College of Agricultural Sciences. (2019). Center for economic and community development: planning your engagement efforts. Retrieved 18 July 2019 https://aese.psu.edu/research/centers/cecd/engagement-toolbox/planning

Peprah, K., Amoah, S. T., & Akongbangre, J. N. (2014). Sack farming: innovation for land scarcity farmers in Kenya and Ghana. *International Journal of Innovative Research & Studies, 3*(5), 29-44.

Peretomode, V., & Ugbomeh, A. (2013). Problems faced by undergraduate and diploma students and their survival strategies in Nigeria: an institutional analysis. *International Journal of Educational Planning & Administration, 3*(1), 25-33.

Perumal, J. (2016). Enacting critical pedagogy in an emerging South African democracy: narratives of pleasure and pain. *Education and Urban Society, 48*(8), 743-766.

Pickering, C. R., Bast Jr, R. C., & Keyomarsi, K. (2015). How will we recruit, train, and retain physicians and scientists to conduct translational cancer research? *Cancer, 121*(6), 806-816.

Poobalan, A., & Aucott, L. (2016). Obesity among young adults in developing countries: a systematic overview. *Current Obesity Reports, 5*(1), 2-13.

Postma, D. (2015). Critical educational research. *Education as Change, 19*(1), 1-9. doi:10.1080/16823206.2015.1036628

Preece, J. (2013). Community engagement and service learning in a South African university: the challenges of adaptive leadership. *South African Journal of Higher Education, 27*(4), 986-1004.

Price, S. (2005). Understanding the importance to health of a balanced diet. *Nursing Times, 101*(1), 30-31.

Prince, H. E. (2019). The sustained value teachers place on outdoor learning. *Education 3-13*, 1-14.

Punch, K. F. (2009). *Introduction to research methods in education*. London: Sage.

Punch, K. F., & Oancea, A. (2014). *Introduction to research methods in education*. Los Angeles: Sage.

Purdue University. (2019). Common problems for students. Retrieved 21 October 2019 https://www.pfw.edu/offices/family-outreach/for-parents-from-sap/commonproblemsforstudents.html

Quigley, B. A. (1997). *Rethinking literacy education. the critical need for practice-based change.* The Jossey-Bass Higher and Adult Education Series. San Francisco, CA: Jossey-Bass.

Raby, R. (2010). Public selves, inequality, and interruptions: the creation of meaning in focus groups with teens. *International Journal of Qualitative Methods, 9*(1), 1-15.

Ramudzuli, M. (2019). *The relationship between income inequality, economic growth and poverty in South Africa* (Master of economics). North-West University, Vanderbijlpark, South Africa.

Rasmussen, D. M. (1996). Critical theory and philosophy. In D. M. Rasmussen (Ed.), *The handbook of critical theory*. Oxford: Blackwell.

Reeves, J. (2018). Teacher identity work in neoliberal schooling spaces. *Teaching and Teacher Education: An International Journal of Research and Studies, 72*(1), 98-106.

Republic of South Africa. (1998). Government Gazette No. 105 of 1998: National Empowerment Fund Act. Retrieved 15 October 2016 https://www.thedti.gov.za/business_regulation/acts/empowerment_fund_act.pdf

Rhodes University. (2001). Constitution of the students. Retrieved 14 September 2019 https://www.ru.ac.za/media/rhodesuniversity/content/institutionalplanning/documents/students_constitution.pdf

Rhodes University. (2016). What is service-learning? Retrieved 23 October 2018 https://www.ru.ac.za/communityengagement/servicelearningengagedresearch/servicelearning/whatisservice-learning/

Rhodes University. (2018). Community engagement in theory and practice. Retrieved 14 November 2018 https://www.ru.ac.za/media/rhodesuniversity/content/digitalpublications/Community%20Engagement%20Theory%20&%20Practice%20Book.pdf

Rifkin, S. B., Muller, F., & Bichmann, W. (1988). Primary health care: on measuring participation. *Social Science & Medicine, 26*(9), 931-940.

Risk, S., & Bilgi, F. (2014). The knowledge about cardiovascular risk factors among students in a faculty of health sciences. *Eurasian Journal of Family Medicine, 3*, 79-84.

Ryan, F., Coughlan, M., & Cronin, P. (2009). Interviewing in qualitative research: the one-to-one interview. *International Journal of Therapy and Rehabilitation, 16*(6), 309-314.

Sabi, S. C., Siwela, M., Kolanisi, U., & Naidoo, D. K. (2018). Complexities of food insecurity at the university of KwaZulu-Natal, South Africa: a review. *Journal of Consumer Sciences, 46*.

Sadeghi, S. (2008). Critical pedagogy in an EFL teaching context: an ignis fatuus or an alternative approach. *Journal for Critical Education Policy Studies, 6*(1), 277-295.

Sakhieva, R. G., Gilmanshina, S. I., Gilmanshin, I. R., Kosmodemyanskaya, S. S., Akchurina, I. R., & Sagitova, R. N. (2015). A Portfolio as an alternative means of presenting the university student's achievements. *Asian Social Science, 11*(3), 162.

Saldaña, J. (2016). *The coding manual for qualitative researchers*. Los Angeles, CA: Sage.

Santoyo-Sánchez, A., Aponte-Castillo, J., Parra-Pena, R., & Ramos-Penafiel, C. (2015). Dietary recommendations in patients with deficiency anaemia. *Revista Médica Del Hospital General De México, 78*(3), 144-150.

Schnettler, B., Miranda, H., Lobos, G., Orellana, L., Sepúlveda, J., Denegri, M., . . . Grunert, K. G. (2015). Eating habits and subjective well-being: a typology of students in Chilean state universities. *Appetite, 89*, 203-214.

Schreier, M. (2014). Qualitative content analysis. In U. Flick (Ed.), *The Sage Handbook of Qualitative Data Analysis*. London: Sage.

Sebeco, L. P. (2019). *Community members' perceptions of higher education institutions' community engagement projects: the case of the WIN platform of the North-West University* (Master of Sociology). North-West University, Potchefstroom, South Africa.

Seehawer, M. (2018). South African science teachers' strategies for integrating indigenous and Western knowledges in their classes: practical lessons in decolonisation. *Educational Research for Social Change, 7*(SPE), 91-110.

Seligman, H. K., Laraia, B. A., & Kushel, M. B. (2009). Food insecurity is associated with chronic disease among low-income NHANES participants. *The Journal of Nutrition, 140*(2), 304-310.

Shizha, E. (2007). Critical analysis of problems encountered in incorporating indigenous knowledge in science teaching by primary school teachers in Zimbabwe. *Alberta Journal of Educational Research, 53*(3).

Shor, I. (1992). *Empowering education: critical teaching for social change*. Chicago: The. University of Chicago Press.

Shor, I., & Freire, P. (1987). What is the “dialogical method” of teaching? *Journal of Education, 169*(3), 11-31.

Silverthorn, D. (2016). Hungry for knowledge: assessing the prevalence of student food insecurity on five Canadian campuses. Retrieved 20 October 2019 http://cpcml.ca/publications2016/161027-Hungry_for_Knowledge.pdf

Simpson, K., & Freeman, R. (2004). Critical health promotion and education—a new research challenge. *Health Education Research, 19*(3), 340-348.

Snyman, L. (2014). *An analysis of community engagement at South African universities* (Doctoral of Philosophy). University of Johannesburg, Johannesburg.

Sood, K. (2016). Writing the proposal. In I. Palaiologou, D. Needham, & T. Male (Eds.), *Doing research in education: theory and practice*. Los Angeles, CA: Sage.

Sorsdahl, K., Slopen, N., Siefert, K., Seedat, S., Stein, D. J., & Williams, D. R. (2011). Household food insufficiency and mental health in South Africa. *Journal of Epidemiology & Community Health, 65*(5), 426-431.

Soundarya, N., & Suganthi, P. (2017). A review on anaemia–types, causes, symptoms and their treatments. *Journal of Science and Technology Investigation, 1*(1).

Specht, K., Siebert, R., Hartmann, I., Freisinger, U. B., Sawicka, M., Werner, A., . . . Dierich, A. (2014). Urban agriculture of the future: an overview of sustainability aspects of food production in and on buildings. *Agriculture and Human Values, 31*(1), 33-51.

Speckman, M., & Mandew, M. (Eds) (2014). *Perspectives on student affairs in South Africa*. Somerset West: African Minds.

Stake, R. E. (1995). *The art of case study research*. Los Angeles, CA: Sage.

Statistics South Africa. (2017). Poverty on the rise in South Africa. Retrieved 16 August 2018 http://www.statssa.gov.za/?p=10334

Statistics South Africa. (2018). P0211 - Quarterly Labour Force Survey (QLFS), 4th Quarter 2018. Retrieved 05 May 2019 http://www.statssa.gov.za/?page_id=1854&PPN=P0211&SCH=7331

Statistics South Africa. (2019). Quarterly Labour Force Survey (QLFS) – Q2:2019 Retrieved 31 July 2019 http://www.statssa.gov.za/?p=12370

Steenekamp, K., van der Merwe, M., & Mehmedova, A. S. (2018). Enabling the development of student teacher professional identity through vicarious learning during an educational excursion. *South African Journal of Education, 38*(1).

Strom, J. d. A. (2011). *Enabling engagement: a study of university-community engagement at a non-metropolitan Australian university.* (Doctor of Philosophy), Southern Cross University, East Lismore, Australia.

Strydom, H. (2011). Ethical aspects of research in the social sciences and human service professionals. In A. S. de Vos, H. Strydom, C. B. Fouché, & C. S. L. Delport (Eds.), *Research at grassroots: for the social sciences and human service professionals*. Pretoria: Van Schaik.

Stukas, A. A., Snyder, M., & Clary, E. G. (2015). Volunteerism and community involvement: antecedents, experiences, and consequences for the person and the situation. *The Oxford Handbook of Prosocial Behavior* (pp. 459-493). Oxford: Oxford University Press.

Sultana, R. G. (1992). Personal and social education: curriculum innovation and school bureaucracies in Malta. *British Journal of Guidance & Counselling, 20*(2), 164-185.

Supski, S., Lindsay, J., & Tanner, C. (2017). University students' drinking as a social practice and the challenge for public health. *Critical Public Health*, *27*(2), 228-237.

Sutherland, L., Howard, S., & Markauskaite, L. (2010). Professional identity creation: examining the development of beginning preservice teachers' understanding of their work as teachers. *Teaching and Teacher Education, 26*(3), 455-465.

Swartz, S., Mahali, A., Arogundade, E., Khalema, E., Rule, C., Cooper, A., . . . Naidoo, P. (2017). *Ready or not!: Race, education and emancipation: a five-year lingitudinal, qualitative study of agency and impasses to success amongst higher education students in a sample of South African universities*. Retrieved 15 October 2019 http://repository.hsrc.ac.za/handle/20.500.11910/11305

Tabachnik, R. (2015). Can vertical gardens end world hunger? Retrieved 21 August 2019 http://nocamels.com/2015/06/israeli-greenwall-vertical-gardens-food/

Tanton, J., Dodd, L. J., Woodfield, L., & Mabhala, M. (2015). Eating behaviours of British university students: A cluster analysis on a neglected issue. *Advances in preventive medicine*, *2015*.

Taylor, J. A., Canfield, J. P., & Larson, K. (2018). FUEL NKU: A campus community hunger initiative. *Journal of Community Engagement and Scholarship, 10*(2), 5.

Taylor, S., & Yu, D. (2009). The importance of socio-economic status in determining educational achievement in South Africa. Unpublished working paper (Economics). Stellenbosch: Stellenbosch University.

Taylor, S. J., Bogdan, R., & DeVault, M. (2015). *Introduction to qualitative research methods: a guidebook and resource*. Hoboken, NJ: John Wiley & Sons.

The California State University. (2007). Community engagement. Retrieved 20 February 2019 http://teachingcommons.cdl.edu/cdip/facultyteaching/Communityengagement.html

The Economist Intelligence Unit. (2018). *Global Food Security Index 2018: building resilience in the face of rising food-security risks*. Retrieved 07 September 2019 https://foodsecurityindex.eiu.com/

The University of British Columbia. (2019). Community engagement. Retrieved 25 July 2019 http://communityengagement.ubc.ca/community-engagement-resources/

Thomson-Bunn, H. (2014). Are They Empowered Yet?: Opening up Definitions of Critical Pedagogy. Retrieved 12 March 2020 https://files.eric.ed.gov/fulltext/EJ1021997.pdf

Tobin, M., Donnelly, K., Graham, C. L., & Tarsi, M. R. (2016). Encouraging service-learning and civic engagement: benefits for all stakeholders. Retreived 12 November 2017 https://vc.bridgew.edu/may_celebrations/2016/session2/23/

Tonelli, G. (1971). The" weakness" of reason in the Age of Enlightenment. *Diderot Studies, 14*, 217-244.

Trichopoulou, Naska, Antoniou, Friel, Trygg, & Turrini. (2003). Vegetable and fruit: the evidence in their favour and the public health perspective. *International Journal for Vitamin and Nutrition Research, 73*(2), 63-69.

Trowler, P., & Trowler, V. (2010). *Student engagement evidence summary*. Lancaster: University of Lancaster, The Higher Education Academy.

Tuckman, B. W., & Monetti, D. M. (2011). *Education psychology*. Belmont, CA: Wadsworth.

Ukegbu, P., Nwofia, B., Ndudiri, U., Uwakwe, N., & Uwaegbute, A. (2019). Food insecurity and associated factors among university students. *Food and nutrition bulletin*, *40*(2), 271-281.

UNESCO. (2017). Local and indigenous knowledge systems. Retrieved 9 September 2019, from United Nations Educational, Scientific and Cultural Organization

http://www.unesco.org/new/en/natural-sciences/priority-areas/links/related-information/what-is-local-and-indigenous-knowledge

United Nation High Commissioner for Refugees - The UN Refugee Agency. (2005). Why self-reliance? Retrieved 01 December 2018, from UNHCR https://www.unhcr.org/afr/publications/operations/44bf3e252/handbook-self-reliance-book-1-self-reliance.html?query=why%20self%20reliance

University of Free State. (2018a). Institutional Student Representative Council. Retrieved 14 September 2019 https://www.ufs.ac.za/docs/librariesprovider31/default-document-library/the-constitution-of-the-institutional-student-representative-council.pdf?sfvrsn=5f1f8f21_0

University of Free State. (2018b). Support Services University of the Free State UFS Home/ Service Learning at our University Home/ Food Garden Projects Retrieved 08 December 2018 https://www.ufs.ac.za/supportservices/departments/service-learning-at-our-university-home/links-for-community-projects/food-garden-projects

University of KwaZulu-Natal. (2018). Student Representative Council Constitution Retrieved 14 September 2019 https://www.ukzn.ac.za/wp-content/uploads/2018/08/UKZN-SRC-Constitution-council-approved-18-June-2018-web-version.pdf

University of Pretoria. (2018). University of Pretoria Yearbook 2018: Faculty of natural and Agricultural Sciences. Retrieved 15 November 2019 https://www.up.ac.za/yearbooks/2018/faculties/view/SCI/Faculty%20of%20Natural%20and%20Agricultural%20Sciences

University of South Africa. (2013). Community engagement and outreach policy Retrieved 23 October 2018, from University of South Africa https://www.unisa.ac.za/static/corporate_web/Content/About/Service%20departments/community%20engagement%20and%20outreach/documents/Commu

nity%20Engagement%20and%20Outreach%20Policy%20-%20rev%20appr%20Council%20-%2020.09.2013.pdf

University of South Africa. (2017). Key Definitions and principles of community engagement. Retrieved 13 November 2018 https://www.unisa.ac.za/sites/corporate/default/About/Service-departments/Community-Engagement-&-Outreach/Key-Definitions-and-Principles-of-Community-Engagement

University of the Western Cape. (2017). *Community Engagement (CE) Colloquium Report*. Retrieved 09 2018: https://www.uwc.ac.za

University of The Witwatersrand. (2018). Students promote gardening on campus. Retrieved 08 December 2018 https://www.wits.ac.za/news/latest-news/general-news/2018/2018-06/students-promote-gardening-on-campus.html

University of ZuluLand. (2018). Policy and procedures on community engagement (framework, guidelines and operating procedures). Retrieved 28 October 2018 http://www.unizulu.ac.za/wp-content/uploads/2019/01/Policy-and-Procedures-on-Community-Engagement.pdf

USAID. (2011). *First principles: community engagement in education programs through the educational quality improvement Program 1 (EQUIP1*. Retrieved 16 July 2018 https://www.edu-links.org/sites/default/files/media/file/ACFrOgD5YbwcFF8yK6PoJJm_VqohrxvgHI5IZpAedgEmrwNT83dVuNtP8Cli5Q1d2zTy2LS0RRhTJtOGXryJOyAPJEbESsV0k8IDMC6VeEEHOLD9SQ6CJi28uX7W4SQ_.pdf

Van den Berg, L., & Raubenheimer, J. (2015). Food insecurity among students at the University of the Free State, South Africa. *South African Journal of Clinical Nutrition, 28*(4), 160-169.

Van Schalkwyk, F. (2015). University engagement as interconnectedness: indicators and insights. Cape Town: Centre for Higher Education Transformation. *Cloete, Maassen, Bailey (Eds.), Knowledge Production and Contradictory Functions in African Higher Education. Cape Town: African Minds*, 203-229.

Van Wyk, M. M. (2017). Exploring student teachers' views on eportfolios as an empowering tool to enhance self-directed learning in an online teacher education course. *Australian Journal of Teacher Education, 42*(6), 1.

Venkat, H., & Spaull, N. (2015). What do we know about primary teachers' mathematical content knowledge in South Africa? An analysis of SACMEQ 2007. *International Journal of Educational Development, 41*, 121-130.

Vithal, R., Adler, J., & Keitel, C. (2005). *Researching mathematics education in South Africa: perspectives, practices and possibilities*. Pretoria: HSRC Press.

Vokatis, B., & Zhang, J. (2016). The professional identity of three innovative teachers engaging in sustained knowledge building using technology. *Frontline Learning Research, 4*(1), 58-77.

Volkov, A., & Volkov, M. (2015). Teamwork benefits in tertiary education: student perceptions that lead to best practice assessment design. *Education+ Training, 57*(3), 262-278.

Von Grebmer, K., Bernstein, J., Nabarro, D., Prasai, N., Amin, S., Yohannes, Y., . . . Thompson, J. (2016). *2016 Global hunger index: getting to zero hunger*: Washington DC: International Food Policy Research Institute

Waghid, Y. (1999). Engaging universities and society through research, teaching and service. *South African Journal of Higher Education, 13*(2), 109-117.

Watson, D., Hollister, R., Stroud, S. E., & Babcock, E. (2011). *The engaged university: international perspectives on civic engagement*. New York, NY: Routledge.

Weber, S. M. (1977). Aesthetic experience and self-reflection as emancipatory processes: two complementary aspects of critical theory. In J. O'Neill (Ed.), *On Critical Theory*. London: Heinemann.

Weigel, M. M., Armijos, R. X., Racines, M., & Cevallos, W. (2016). Food insecurity is associated with undernutrition but not overnutrition in Ecuadorian women from low-income urban neighborhoods. *Journal of Environmental and Public Health, 2016*.

Welle, D. (2011). Hunger is a political problem. Retrieved 20 September 2019 https://www.dw.com/en/hunger-is-a-political-problem/a-15459224

Western Cape Government Education. (2013). *Media release Minister of Education Donald Grant Western Cape: Background to the national quintile system*. Retrieved 12 September 2019 https://wcedonline.westerncape.gov.za/comms/press/2013/74_14oct.html.

Weston, D. (2015). *The political economy of global warming: the terminal crisis*. London: Routledge.

Wickham, S., Jones, B., Coetzee, G., & Bailey, T. (2008). *Factors that facilitate success for disadvantaged higher education students. An investigation into approaches used by REAP, NSFAS and selected higher education institutions.* Cape Town: Rural Education Access Program (REAP).

Wilson, C., Manners, P., & Duncan, S. (2014). Building an engaged future for UK higher education. Retrieved 25 July 2019 https://www.publicengagement.ac.uk/sites/default/files/publication/t64422_-_engaged_futures_final_report_72.pdf

Wilson, L. (2013). *A framework for effective practice in community engagement in higher education in a postgraduate programme at North-West University* (Doctor of Philosophy). Stellenbosch University, Stellenbosch.

Woodcock, M. (2017). *Team development manual*. New York: Routledge.

World Food Programme. (2009). *Hunger and markets* (Vol. 3). London: Earthscan.

World Health Organisation. (2019). Global strategy on diet, physical activity and health. Retrieved 03 September 2019 https://www.who.int/dietphysicalactivity/goals/en/

Yin, R. K. (2014). *Case study research and applications: design and methods*. Los Angeles: Sage publications.

Zamawe, F. C. (2015). The implication of using NVivo software in qualitative data analysis: Evidence-based reflections. *Malawi Medical Journal, 27*(1), 13-15.

Zeelen, J. (2012). Universities in Africa: Working on Excellence for Whom? Reflections on Teaching, Research, and Outreach Activities at African Universities. *International Journal of Higher Education*, *1*(2), 157-165.

Zellner, D. A., Loaiza, S., Gonzalez, Z., Pita, J., Morales, J., Pecora, D., & Wolf, A. (2006). Food selection changes under stress. *Physiology & behavior*, *87*(4), 789-793.

Zhan, J., Liu, Y. J., Cai, L. B., Xu, F. R., Xie, T., & He, Q. Q. (2017). Fruit and vegetable consumption and risk of cardiovascular disease: A meta-analysis of prospective cohort studies. *Critical reviews in food science and nutrition*, *57*(8), 1650-1663.

Zick, C. D., Smith, K. R., Kowaleski-Jones, L., Uno, C., & Merrill, B. J. (2013). Harvesting more than vegetables: the potential weight control benefits of community gardening. *American Journal of Public Health, 103*(6), 1110-1115.

Zygmantas, J. (2009). Understanding critical pedagogy and its impact on the construction of knowledge. *Acta Paedagogica Vilnensia, 23*(23).

APPENDICES

APPENDIX 1

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

29 June 2016

Mr Oluwakemi Ayodeji Adebayo (SN 214581977)
School of Education
College of Humanities
Edgewood Campus
UKZN
Email: 214581977@stu.ukzn.ac.za

Dear Mr Adebayo

RE: PERMISSION TO CONDUCT RESEARCH

Gatekeeper's permission is hereby granted for you to conduct research at the University of KwaZulu-Natal (UKZN), towards your postgraduate studies, provided Ethical clearance has been obtained. We note the title of your research project is:

"Exploring university community engagement by pre-service science teachers through the study of a Biology module at a South African university".

It is noted that you will be constituting your sample by conducting interviews with students who study the Biological Sciences for Educators 310 module as well as with students who do not study this module but who live at the residences on the Edgewood Campus.

Please ensure that the following appears on your questionnaire/attached to your notice:

- Ethical clearance number;
- Research title and details of the research, the researcher and the supervisor;
- Consent form is attached to the notice/questionnaire and to be signed by user before he/she fills in questionnaire;
- gatekeepers approval by the Registrar.

Data collected must be treated with due confidentiality and anonymity.

Yours sincerely

MR SS MOKOENA
REGISTRAR

Office of the Registrar
Postal Address: Private Bag X54001, Durban, South Africa
Telephone: +27 (0) 31 260 8005/2206 **Facsimile:** +27 (0) 31 260 7824/2204 **Email:** registrar@ukzn.ac.za
Website: www.ukzn.ac.za

1910 - 2010
100 YEARS OF ACADEMIC EXCELLENCE

Edgewood Howard College Medical School Pietermaritzburg Westville

APPENDIX 2

Science and Technology Cluster,
School of Education,
College of Humanities,
University of KwaZulu-Natal,
Edgewood Campus, KwaZulu-Natal
22-02-2017.

Dear Participant,

INFORMED CONSENT LETTER - Biology student (PSST participants)

My name is Mr. Adebayo O.A. I am a Doctor of Philosophy (PhD) student from the Science and Technology Cluster, School of Education, College of Humanities, University of KwaZulu-Natal. I am conducting research titled 'Exploring university community engagement by pre-service science teachers through the study of a Biology module in a South African university'.

A review of literature suggests that material poverty among students at tertiary institutions locally and globally influence their academic achievement negatively. The consideration of the socio-economic conditions and how these influence the quality and quantity of the universities' throughput and the well-being of graduating students is essential.

In view of the foregoing, I intend to explore the university community engagement by pre-service science teachers through the study of a Biology module. The objectives of the research are as follows:

1. To explore how pre-service science teachers implement university-community engagement through their study of a Biology module.
2. To examine pre-service science teachers' views about requirements for effective university-community engagement through a Biology module.

3. To determine pre-service science teachers' views about how university-community engagement can influence the well-being of students at a university.
4. To assess how engaging in a university community-engagement project influences pre-service science teachers' professional identity for their future practice.

You are requested to please participate in the study. To gather the information, I am interested in requesting you participate in this project by reflecting critically on a food garden which will be established through the module for a period of 12 weeks. I will also ask you some questions during one group and one individual interview, each of 25-30 minutes duration. In addition, I will also ask you to keep a reflective diary and a student portfolio, in which you can record your views and experiences during the same period of time.

Please note that:

- Your participation is voluntary. If you do not participate you will not be penalized in any way. No marks will be deducted from your project if you decline to participate.
- Your confidentiality is guaranteed as your inputs will not be attributed to you in person but reported only as a population member opinion.
- The focus group and individual interviews (1 of each) will last for about 25-30 minutes and may be split depending on your preference.
- Any information given by you cannot be used against you, and the collected data will be used for purposes of this research only.
- Data will be in the form of interview transcripts, completed diary entries and completed portfolios, and will be stored in secure storage and destroyed after 5 years.
- You have a choice to participate, not participate or stop participating in the research. You will not be penalized for taking such an action.

➢ The research aims at 'Exploring university community engagement by pre-service science teachers through the study of a Biology module in a South African university'.

- Your involvement is purely for academic purposes only, and there are no financial benefits involved.
- If you are willing to be part of the garden project and interviews, please indicate (by ticking as applicable) whether or not you are also willing to allow recording by the following equipment:

Digital audio recording of interviews	Willing	Not willing

Thank you

Yours faithfully

Mr. Adebayo O.A

My contact details are as follows:

Email: 214581977@stu.ukzn.ac.za

Cell: 0849848322

My supervisor is Dr. Ronicka Mudaly. She is a Senior Lecturer at the Science and Technological Education Cluster, School of. Education, College of Humanities, Edgewood Campus, University of KwaZulu-Natal

Contact details:

Email: mudalyr@ukzn.ac.za

Phone number: 031 260 3643.

You may also contact the Research Office at:

University of KwaZulu-Natal

Humanities and Social Sciences Research Ethics

Govan Mbeki Centre

Tel +27312604557

Fax +27312604609

Thank you for your contribution to this research.

DECLARATION

I …… (Full names of participant) hereby confirm that I understand the contents of this document and the nature of the research project, and I consent to participating in the research project.

I understand that:

- **I will participate voluntarily and am at liberty to withdraw from the project at any time, should I so desire, with no negative consequences.**
- **I voluntarily give permission for the study's activities to be digitally recorded.**
- **I give permission for my reflective diary and student portfolio to be used as a source of data.**
- **My identity will not be disclosed.**

……...

Name of Participant

…… ……

Signature of Participant **Date**

APPENDIX 3

Science and Technology Cluster,
School of Education,
College of Humanities,
University of KwaZulu-Natal,
Edgewood Campus, KwaZulu-Natal
22-02-2017.

Dear Participant,

INFORMED CONSENT LETTER – Non-Biology residence student (Non-Biology PST participants)

My name is Mr. Adebayo O.A. I am a Doctor of Philosophy (PhD) student from the Science and Technology Cluster, School of Education, College of Humanities, University of KwaZulu-Natal. I am conducting research titled 'Exploring university community engagement by pre-service science teachers through the study of a Biology module in a South African university'.

A review of literature suggests that material poverty among students at tertiary institutions locally and globally influence their academic achievement negatively. The consideration of the socio-economic conditions and how these influence the quality and quantity of the universities' throughput and the well-being of graduating students is essential.

In view of the foregoing, I intend to explore the university community engagement by pre-service science teachers through the study of a Biology module. The objectives of the research are as follows:

1. To explore how pre-service science teachers implement university-community engagement through their study of a Biology module.

2. To examine pre-service science teachers' views about requirements for effective university-community engagement through a Biology module.
3. To determine pre-service science teachers' views about how university-community engagement can influence the well-being of students at a university.
4. To assess how engaging in a university community-engagement project influences pre-service science teachers' professional identity for their future practice.

You are requested to please participate in the study. To gather the information, I am interested in requesting you participate in this project by observing a food garden which will be established by BIO 310 students for a period of 12 weeks. You are invited to learn the skills related to establishing food gardens. I will also ask you some questions during one group and one individual interview, each of 25-30 minutes duration. In addition, I will also ask you to keep a reflective diary in which you would have recorded your views and experiences during the same period of time.

Please note that:

- Your participation is voluntary. If you do not participate you will not be penalized in any way. No marks will be deducted from your project if you decline to participate.
- Your confidentiality is guaranteed as your inputs will not be attributed to you in person but reported only as a population member opinion.
- The focus group and individual interviews (1 of each) will last for about 25-30 minutes and may be split depending on your preference.
- Any information given by you cannot be used against you, and the collected data will be used for purposes of this research only.
- Data will be in the form of interview transcripts, completed diary entries and completed portfolios, and will be stored in secure storage and destroyed after 5 years.
- You have a choice to participate, not participate or stop participating in the research. You will not be penalized for taking such an action.
- The research aims at 'Exploring university community engagement by pre-service science teachers through the study of a Biology module in a South African university'.
- Your involvement is purely for academic purposes only, and there are no financial benefits involved.

- If you are willing to be part of the garden project and interviews, please indicate (by ticking as applicable) whether or not you are also willing to allow recording by the following equipment:

Digital audio recording interviews	Willing	Not willing

Thank you
Yours faithfully

Mr. Adebayo O.A
My contact details are as follows:
Email: 214581977@stu.ukzn.ac.za
Cell: 0849848322

My supervisor is Dr. Ronicka Mudaly. She is a Senior Lecturer at the Science and Technological Education Cluster, School of. Education, College of Humanities, Edgewood Campus, University of KwaZulu-Natal
Contact details:
Email: mudalyr@ukzn.ac.za
Phone number: 031 260 3643.

You may also contact the Research Office at:
University of KwaZulu-Natal

Humanities and Social Sciences Research Ethics

Govan Mbeki Centre

Tel +27312604557

Fax +27312604609
Thank you for your contribution to this research.

DECLARATION

I …… (Full names of participant) hereby confirm that I understand the contents of this document and the nature of the research project, and I consent to participating in the research project.

I understand that:

- **I will participate voluntarily and am at liberty to withdraw from the project at any time, should I so desire, with no negative consequences.**
- **I voluntarily give permission for the study's activities to be digitally recorded.**
- **I give permission for my reflective diary and student portfolio to be used as a source of data.**
- **My identity will not be disclosed.**

……...

Name of Participant

…… **……**

Signature of Participant **Date**

APPENDIX 4

UNIVERSITY OF KWAZULU-NATAL

UNIVERSITY OF KWAZULU NATAL

COLLEGE OF HUMANITIES

SCHOOL OF EDUCATION

Motivation for Change of Dissertation/ Thesis Title

NAME OF STUDENT: **Oluwakemi Ayodeji Adebayo**

STUDENT NUMBER: **214581977**

CAMPUS: Edgewood x Pietermaritzburg ☐

DEGREE PhD (Science Education)

SCHOOL: Education

NAME OF SUPERVISOR: Professor Ronicka Mudaly

NAME OF CO-SUPERVISOR: N/A

CURRENT TITLE: Exploring University Community Engagement by Pre-service Science Teachers through the Study of a Biology Module

NEW TITLE: Exploring University-Community Engagement by Pre-service Science Teachers through the Study of a Biology Module

11.10.19

MOTIVATION FOR CHANGE/ALTERATION OF DISSERTATION/THESIS TITLE:

University community engagement (UCE) is not being studied in its conventional way, where the community lies outside the university. In this study the community comprises residence students. Therefore the link between university and community needed to be strengthened, and University-community engagement (U-CE) is argued for.

DATE: 10/10/19 STUDENT SIGNATURE: _____

DATE: 10 October 2019 SUPERVISOR: _____

DATE: N/A CO-SUPERVISOR: N/A

11.10.19

APPENDIX 5

Focus Group Interview Questions for Biology students (PSST participants):

Date of interview:

Time of interview:

Venue of interview:

1. How long did you do the food garden exercise?
2. Having participated in this food garden project, how can the pre-service Biology students in this university carry out this program/project to assist the community of students from poor background that live in the residences of the university?
3. You did work with one or two non-Bio students residing in the residence, what skills did you think you imparted on them? How can these knowledges assist the students?
4. Research has shown that the lack of adequate nutrition among university students shows the prevalence of poverty affecting the student population, how can this project help the feeding and nutrition of students who reside on residence and have nutritional challenges?
5. Do you think residence students from poor socioeconomic background can develop initiative, self-drive, self-reliance and resilience if they know about this garden project?
6. Research indicates that Community Engagement by students (like you) allows them to have experiential learning and it also provides solutions to the community's requirements. Do you think this garden project has given you experiential learning and provided solutions to the students' community's needs? Please explain.
7. What attitude or impression have you developed after completing this exercise? How do you feel? Explain.
8. Do you think food gardens; the knowledge and skills can bring about intellectual freedom from the bondage of slavery?
9. Can this project bring change/transformation in the socioeconomic conditions of students from disadvantaged background? Explain.

10. What were the challenges that you encountered during practicing of this project?
11. How can these challenges be overcome?
12. How can this idea of food gardening be improved so that more historically disadvantaged and less privileged students residing in the campus residence can get involved?

APPENDIX 6

Focus Group Interview Questions for Residence students (Non-Biology PST participants):

- How long has it been in this university?
- How has it been feeding yourself and coping with your studies?
- Socioeconomic
- Funding
- How long did you observe the food garden exercise with the BIO students?
- Having participated in this food garden project, how can the pre-service Biology students in this university carry out this program/project to assist the community of students from poor background that live in the residences of the university?
- What knowledge and skills did you gain from the BIO students while observing food garden grow from the planting stage to the harvesting stage? How can these knowledges assist you as residence student in terms of alleviating your nutritional challenges?
- Do you think food gardening can reduce poverty and inequality in South Africa? Please explain.
- Research has shown that the lack of adequate nutrition among university students shows the prevalence of poverty affecting the student population, how can this project help the feeding and nutrition of students who reside on residence and have nutritional challenges?
- Do you think residence students from poor socioeconomic background can develop initiative, self-drive, self-reliance and resilience if they know about this garden project?
- Research indicates that Community Engagement by students (like you) allows them to have experiential learning and it also provides solutions to the community's requirements. Do you think this garden project has given the BIO 310 students experiential learning and provided solutions to the students' community's needs? Please explain.
- Do you think food gardens; the knowledge and skills can bring about intellectual freedom from the bondage of slavery?

- Can this project bring change/transformation in the socioeconomic conditions of students from disadvantaged background? Explain.
- What were the challenges that you encountered while participating in this project?
- How can these challenges be overcome?
- How can this idea of food gardening be improved so that more historically disadvantaged and less privileged students residing in the campus residence can get involved?
- Did you get any form of empowerment from participating in this study? Please elaborate.
- Do you think you can share the knowledge of food gardening with members of your families and communities? Please elaborate.

APPENDIX 7

Individual Interview Questions for Biology students (PSST participants):

- You narrated your experiences of learning to be self-reliant through practicing food gardening, what was your best moment during this project?
- How far do you think food gardening can go to reduce poverty and inequality among students from the previously disadvantaged homes? Do you think students like yourself should engage in community service as it relates to food security?
- Has participating in this project developed your service-learning skills and encouraged you to give a helping hand to the community you find yourself, please explain further.
- Can you explain further how getting involved in this research has affected your views and attitudes as a prospective Life Sciences teacher?
- Can you elaborate on how the knowledge you had gained can be shared among the members of your family and community?
- What sort of empowerment have you achieved in this research?
- You mentioned that you encountered some challenges like…, do you think these problems can prevent you from doing this garden program or any other project like this again?
- How have these challenges made you to become?
- How can this project be improved to benefit the students on campus that stay in the university residences who are from poor socio-economic backgrounds?

APPENDIX 8

Individual Interview Questions for Residence students (Non-Biology PST participants):

- You narrated your experiences of learning to be self-reliant through practicing food gardening, what was your best moment during this project?
- How far do you think food gardening can go to reduce poverty and inequality among students from the previously disadvantaged homes who are residing in the university residence?
- Can you explain further how getting involved in this research has affected your life.
- Can you elaborate on how the knowledge you had gained can be shared among the members of your family and community?
- What sort of empowerment have you achieved in this research?
- What change/transformation do you expect to come out of this project?

APPENDIX 9

Exploring university community engagement by pre-service science teachers through the study of a Biology module.

PhD research work of Mr Adebayo O.A

Reflective Journal (Food Garden)

Name: _____

Group: _____

Date: May 2017

Type: Pre-service Science Student (PSST)

1. What benefits do you think this exercise will achieve in terms of engaging the residence campus student community?

2. What has been the challenges you have had and how did you overcome them?

3. How has teaching and enlightening the non-Bio student who is observing your plot been?

4. Do you think that this project can influence the nutritional well-being of the non –Bio students who come from poor families in the university? Can it meet their nutritional needs?

5. Do you think the residence student's strength and resilience over food insecurity/lack of adequate food can improve through this food gardening?

6. Can garden project reduce poverty and bring about empowerment South Africa students residing in the residence?

7. What indigenous crop did you plant and what is the nutritional value to students residing on university residence?

8. Mention the other crops that you have planted and their nutritional benefits? If not planted, why?

9. Research indicates that Community Engagement by students (like you) allows them to have experiential learning and it also provides solutions to the community's requirements. Do you think this garden project has given you experiential learning and provided solutions to the students' community's needs? Please explain.

10. What attitude or impression have you developed after completing this exercise? How do you feel? Explain briefly.

11. Any other comment you may want to add?

APPENDIX 10

Exploring university community engagement by pre-service science teachers through the study of a Biology module.

PhD research work of Mr Adebayo O.A

Reflective Journal (Food Garden)

Name: _____

Group: _____

Date: May 2017

Type: Non-Biology Pre-service Teacher (NBPST)

1. Having been observing and learning from the garden project; do you think this project can positively influence the nutritional well-being of students living on university campus residences who come from low socio-economic background? Explain your answer.

2. Have you ever felt like giving up while participating in this project? Yes or No. If yes, why? And if no why?

3. Can the situation of the community of students living on residence who struggle with feeding be transformed through this initiative of the BIO students'/BIO module? Explain?

4. Do you think you have developed some form of resilience (ability to endure tough times) through observing the food garden project of the BIO 310 students? Please explain.

5. What knowledge and skills did you observe from this food garden experience?

6. Do you think food gardens; the knowledge and skills can bring about intellectual freedom from the bondage of slavery? Briefly describe your views.

7. Can this project bring change/transformation in the socio-economic conditions of students from disadvantaged background? Explain.

8. What kind of empowerment (if any) have you gained from participating in this study? Please elaborate.

9. Any other comment you may want to add?

APPENDIX 11

FOCUS GROUP INTERVIEW: BIOLOGY STUDENTS 1 (FGI BS1)

Mr Adebayo: Good day

Interviewees: Good day sir (chorus)

Mr Adebayo: You are welcome to this focus group interview. The title of this research that I am doing… my name is Mr Adebayo; I am a PhD student and the title of this research is 'Exploring university engagement by Pre-service Science Teachers through the study of a Biology module. So, I welcome you and thank you for being part of garden activities for the past couple of months. Hmm… today is the 12th of May 2017 and the time is 12:21 (12h21). So, I am just going to ask you some questions based on your experience on the garden project which you have been doing in Biology; EDBS 310 (Module).

Now, how long did you do the food garden exercise?

Participant 1: Well we can say it took us about 3 months; February, March and April (2017).

Mr Adebayo: Okay. You can speak a bit louder?

Participant 1: Oh… it took us a period of 3 months which is February, March, April 2017

Mr Adebayo: Thank you. Anyone can speak, feel free and feel relaxed.

Hmm… having participated in this food garden project, how can pre-service Biology students carry out this program to assist the community of students from poor background that live in the residences of the university?

Participant 1: Hmm…

Participant 2: The question is like how they can (Pre-service Biology students) take the project and advertise it or how is it effective to students…

Mr Adebayo: Yes… how can students who are struggling benefit from the project.

Participant 2: Oh… I think they can benefit a lot… because the project teaches them about nutrition, it teaches them hmm… what specific indigenous food that you can

plant and grow err… yea… I think they can benefit a lot and it is not expensive… it is not expensive, it's just… it needs err… motivation... it does need motivation. It is not expensive; you just need to start and then you plant.

Mr Adebayo: Ok

Participant 3: According to myself, am staying at… those students who come from poor backgrounds, they can start their own gardens; therefore, they won't have to spend money on buying vegetables and fruits and stuffs and so the money that they are supposed to spend vegetables they can use it to do something else so it saves money.

Participant 4: To add on that err… it is more… it is much more effective or safer if you plant your own plant and then grow them you eat them because those which we buy from shops; they are processed. Sometimes processed things are not healthy for us so it is better if you grow your own garden and then you eat those natural and healthy plants.

Mr Adebayo: Okay thank you. Is there any more view?

Participant 1: And to add on Sindy's point (not real name – participant 4), we can say those that you bought from major groceries stores (2 examples mentioned withheld to avoid controversy), there is something which is called GMO (Genetically Modified Organisms) which have got the negative impact in our lives. So, it is better to plant your own crops and eat them.

Mr Adebayo: Ok; thank you. You did work with one or two non-BIO students residing in the residence, which skill did you think you imparted on them?

Participant 5: Plantation skills

Mr Adebayo: Pardon me?

Participant 5: Plantation skills

Mr Adebayo: Plantation skills? What do you mean by plantation skills?

Participant 5: Well they didn't have an idea of how they should plant crops… so when we were there, we assisted them on how they should plant.

Mr Adebayo: OK

Participant 2: Ok**,** we also taught them about soil preparation; how they can prepare soil without using any fertilizers (inorganic fertilizer) but only using the compost from their homes, the peelings of the potatoes and the carrots and also using the dead leaves, the grass, and also how to… how to grow plants without using any pesticide which may be harmful to your health in the long period.

Participant 1: And also, to know which vitamin are contained by particular type of crops.

Mr Adebayo: Ok. Thank you. Hmm… research has shown that the lack of adequate nutrition among university students shows the prevalence of poverty affecting the students' population (Source?). How can this project help the feeding and nutrition of students who on residence (campus residence) and help their nutritional challenges?

Participant 3: As Ntombi (pseudonym) had said, err… the crops that we from shops; they have GMOs (Genetically Modified Organisms) … GMOs have very bad effect to our bodies. So, by planting their own crops and eating them; those ones are not processed; so, they are much healthier and more nutritious than those whom we buy from shops.

Mr Adebayo: Ok. Alright. Hmm… this question says do you think residence students from poor socioeconomic background can develop initiative, self-drive, self-reliance and resilience if they know about this project?

Participant 2: Yes… I think they do because err… they … the gardening is not err… as I have said it (gardening) is not expensive so they will be motivated because they need err… they need source of food… so they need something… someone to provide so they cannot rely on money because they do not have money. They will use their hands and start a garden. I think the garden project will help them to be motivated so that they can start err… small and then grow more gardens.

Participant 1: To add on that, they can even take the project to their homes if at home the financial status is not that good, they can start their own gardens instead of buying from the shops.

Mr Adebayo: Ok. Yes, you were trying to say something.

Participant 5: What I wanted to say, she had already said it.

Mr Adebayo: Okay. So you saying that… they can… it can help them (Non-BIO students residing in the residence) because resilience… you don't want to give up… because some people drop out they see… or they can't manage (survive) in the university… maybe they are not funded or … So, if they have or they are involved in this project you are saying that they can still hang on?

All participants: Yes

Mr Adebayo: That's what you are saying?

All participants: Yes

Mr Adebayo: Hmm… research indicates that community engagement by students like you allows them to have experiential learning and it also provides solution to community requirements (source?). Do you think this garden project has given you experiential learning and provided solutions to the students' community needs? Please

Participant 3: Okay For experiential learning… Okay, firstly… we must come out with something unique to plant. We must learn new vitamin… we must learn the vitamin that we get from the… from the crops and how they help to body. We have to learn to work collaboratively as a group and also we have to learn from our own knowledge, the new strategies on how to plant… how to plant, how to prepare soil, how plants grow, how to take care of them, how to water, irrigation and all those things and then this … this can also provide solution to the community, who are highly effected by the poverty, as South Africa as a developing country because most students here,… they suffer from *ama* (those)… night-blindness and decided to plant carrots, spinach and also *dumbi* (Amadumbis) which can help them a lot and also the communities from the people who are old, who can't see clearly, these are the easy ways that they can get the vitamins without having to go to the doctors to buy… glasses and everything, they can just plant these and get the vitamins which are free and they do not have any chemicals that can harm their bodies.

Mr Adebayo: Okay…. any other one? Because experiential learning is err… you ought to learn through err… you're leaning through experience and putting what you… the theory into practice. Alright? So-

Participant 3: Yes. And… and also, we learnt hmm… indigenous ways of planting. Nowadays technology is much used than indigenous ways, so this project has also helped us to remember and redo the indigenous ways.

Mr Adebayo: Now what attitude or impression have you developed after completing this exercise? What's your attitude now, how do you feel?

Participant 2: Err… I've developed consistency because… like the project was not that easy because we started err… from planting and we had to plat and we had to monitor each and every day, the garden… so sometimes it was so… I was so tired sometimes but I kept on going because I had to see something growing and when the… when the crops started to grow, I was motivated even more to continue monitoring the garden, watering so that I can have the end result. I was actually consistency… yea… that is what I-

Participant 1: And also, patience because these plants do not take err… little time to grow. They take a very long time and you need to be patient and to wait to see them grow also.

Mr Adebayo: Okay

Participant 1: Yes

Mr Adebayo: Yes… Any… Any other attitude?

Participant 4: As a teacher… as a teacher, you're going to be a teacher. How do you think about attitudes?

Participant 2: As a teacher, I've learnt err… how to work with people and accepting other people's opinions even though… if I have an opinion, let me say… if I have an opinion, I must not oppose another person's opinion without even hearing the advantages and disadvantages of their opinion. So, I have to be open-minded, it taught me to be … open-minded about different things.

Mr Adebayo: Okay…. Thank you. And now do you think the food gardens, the knowledge and the skills can bring about intellectual freedom from the bondage of poverty?

Participant 4: Yes, definitely…. It can bring intellectual freedom from the bondage of poverty since we rely mostly on… mostly on the jobs… that you must find a job to feed

your family. So the… this project, the gardens you'll know that from… in order to feed your family you have to go and have your own garden, prepare the soil using the compost that may not need any money and you all… all you need is plants and you can grow the crops that can grow and feed your family.

Mr Adebayo: Yes…. Any other view…? Okay, can it also bring transformation you know, the government is talking about transformation change. It can… Can it? It can change the historical err… issues we have in South Africa.

All participants: Yes, it can. (Chorus)

Participant 2: Yes, also I think it can err… it can change each and everything because immediately you know what your goal is, you strive for that goal. So, I think people must understand why they do something… so that it can motivate them to… their goal.

Participant 3: I think also… South Africa is currently facing the issue of poverty due to of… of population. So if one person in your family can plough… can have his own farm or garden that can prevent a lot of people suffering from different diseases and also it can… that can prevent a lot of people suffering from diseases because these plants… they are organic (hmm… and indigenous) - from other participant they're indigenous.

Mr Adebayo: Okay. What are some of the challenges that you came across? You can mention them… while you were doing the programme

Participant 4: Okay… the soil was dry, so we had to prepare it by irrigating it and it was infertile, so we had to go and look for compost without having to use fertilisers-

Participant 2: Also, our biggest challenge was that we err… planted… our plant was underneath trees so, each and every time when we had to monitor there were leaves falling… there were leaves falling and they flattened our crops so, it was the biggest challenge and other crops did not grow well because each and every time when we had to monitor and remove the… the leaves which were falling.

Participant 3: And, there was too much shade. The plants need the sun, as we all know, to photosynthesise but then there were taller trees, so they blocked the sun for the… our crops so they did not grow that very well because of that.

Mr Adebayo: Okay. So, how… how did you overcome them?

Participant 3: Oh… we tried to overcome them by inserting the net err… over the garden but our idea didn't make it, it failed.

Mr Adebayo: You put a net over the garden?

Participant 3: Yes, we tried but we failed also… yes but we were just trying to overcome this challenge that we were faced with.

Participant 2: Also, I… err… forgot to mention our challenge… another challenge… our challenge was also err… our crops were… were eaten every time when we came to monitor, they were eaten, so we tried err… monitoring each and every time in terms of the leaves that were falling so we tried to remove them each and every day as long… monitoring each and every day we tried to remove the… the leaves.

Mr Adebayo: So, you were constantly on guard taking the leaves out but-

Dr Ronicka: What did you do with the pests? The pests were the problem how did you overcome that?

Participant 2: Err… we didn't have a… a clear solution because some suggested that we must plant a… a flower so that when the… when the pests come to our site, they will be attracted to the flower and be distracted. Also hmm… to control our pests, we also planted our crops err… using companion planting, so it was like our spinach… we planted our spinach in one row on the second row it was carrots then we did it that part to control our pests so that our pests can be confused.

Dr. Ronicka: Did you plant any pest repellent co-… crops marigold, garlic?

Participants 2 & 3: No.

Participant 2: We got that information at a later stage-

Dr. Ronicka: How did you overcome the pest problem? Did you overcome it?

Participant 2: We tried to control them by planting like when we planted mixed crops**.**

Participant 1: Yeah, that's the only way we managed to do it.

Participant 3: I think also the dead leaves were the most thing that attracted the pests. So, by removing the dead leaves each day it was one of the controlling things.

Mr Adebayo: Okay. I think we are getting to the end. Hmm… now having done this project, how can this food err… food gardening be improved so that historically disadvantaged and less privileged students residing in the campus residence can get involved and they can benefit… how do you think it can be improved, made bigger or something?

Participant 3: Well I think if there can be more learners… more students I mean, involved in this project to maybe start a farm or something because there is land down there where we started our gardens so when… many students can be involved there can be a big garden where they can plant and then this project could be much more progressive.

Participant 2: Also, I think one thing that can make err… the project to be bigger is to educate people about why is it that we are supposed to plant indigenous food and we are supposed to do it by ourselves? Why? And to make them seethe importance, I think we must educate them to see the importance so that it can grow.

Participant 3: I think as a biological teacher so if you can't come to Edgewood campus and choose to major in Biology it (the garden project) should be compulsory for you to have a garden so that when you go to school and teach about nutrition, you teach about something you know something you have experienced before. You don't just… don't just teach about something you read in the book, you let the learners explore so that you can even get the… the motive to start gardens even at schools where you'll be going out to the communities.

Mr Adebayo: Okay. Alright. So, is there any other thing you like want to add or… or say?

Participant 3: At the start of this project it felt like it was… something big to do and maybe we couldn't handle it but at the end we managed to handle it and it went very well and it taught us many things.

Participant 5: Did you feel empowered?

Participant 3: Yes, I do feel empowered as a teacher because now, I have information on how to start indigenous gardens and if I get a job maybe at a disadvantaged school where disadvantaged learners learn, I can even start a garden there to help them take

their crops home and the feed their families if maybe the parents are long gone or they are the only ones who are able to sponsor their families.

Mr Adebayo: Okay.

Mr Adebayo: Hmm…. Yeah, I said “Do you think food gardens, knowledge and skills can bring about intellectual freedom from the bondage of poverty of slavery?”

Supervisor: Can… can you… can you … see how what you have said? You have the skills; you will take the skills to your school; you will teach them (learners). It will free your mind too actually, because you have the power and the knowledge. Now it frees you to actually enable other people.

Mr Adebayo: Alright. So, on a lighter note, what are you going to do with your harvest?

Participant 3: I will carry on watering the garden until the plants are matured and then we’ll take them and cook it.

Mr Adebayo: And give Mr. Adebayo some.

Participant 3: I’ll also give you.

Mr Adebayo: Alright. Thank you very much for your time, I really appreciate bye.

APPENDIX 12

INDIVIDUAL INTERVIEW: Preservice Science Teacher 4 (II4 PSST)

Mr Adebayo: Good day….

Interviewee: Good day sir….

Mr Adebayo: how are you?

Interviewee: I'm fine and you?

Mr Adebayo: I'm very well, umh… this is an interview section of a… PhD research that I'm doing. The interview is exploring the university community engagement by pre-service teacher through the study of the biology module. Uhm…. Sometime before last week to be precise, on Friday 15 May 2017, we had a focus group interview with your group and you were selected to come and participate in this individual interview just take the part to those things that were discussed by the participants. So today is a… the 15/05/2017 and the time is a…. 13:42, so I welcome you. Uhm…. The first question says, you narrated your experiences of learning to be self-reliant and uhm… ah… through the practicing of food gardening. What was your best moments during the project?

Interviewee: The garden project?

Mr Adebayo: Yes.

Interviewee: Hmm…. My best moments were when we the seeds started to grow; it was nice to see that there was progress because we started from…. We started our garden from planting seeds and when it started seedling, yah it was the best moment and we started to water the garden.

Mr Adebayo: ok, can you say you are self-reliant now, you can stand on your own?

Interviewee: Yeah, I can say so because now know that I can make something out of nothing since we started doing our garden from a place where there was too much weeds and grass and everything. So, we started planning then we made beds and we do soil preparation and staff and at the end the was…. That I can rely on as now we have the garden and where there's crops growing on. So, I say that I can rely on myself.

Mr Adebayo: thank you, how far do you think food gardening can go to reduce poverty and inequality among students from the previously disadvantaged homes?

Interviewee: I think if… if many students can be involved in such projects like everyone in the university maybe make it like a compulsory module or something because it will help students to have something to rely on like whenever there's a shortage of vegetables or food they know that they have a garden instead of going to shop to buy or worrying about where they gonna get the money to buy food and vegetables and staff. Yeah these are also beneficial because they have nutrients.

Mr Adebayo: ok, uhm… do you think students like yourselves should engage in community service that relate to food security.

Interviewee: yes, I can because now I've been involved in such projects where we are planting…. where we are planting crops that have different nutrients. So, I can be able to guide some other people in the community in terms of educating them about the nutrients that we get in different crops and vegetables.

Mr Adebayo: ok thank you, has participating in this project developed your service-learning skills and encouraged you to give a help to the community?

Interviewee: Yes, it has coz now at… when was at home I feel like it was like it was…. I feel lazy to go to the garden and staff coz my grandmother has some sort of a garden but I wasn't encouraged to go to the garden but now since I have also involved myself in such projects I know that I can be able to go and help other people and also help my grand and other people that also want to grow sample like this garden, it has encouraged me, I know….. I know where it starts, and I also had some information skills about how to control pests and staff even though our garden had too much pests, but we did…. but know what to use in future.

Mr Adebayo: ok, uhm… can you explain further how getting involved in this has affected your values and attitudes as a prospective life science teacher?

Interviewee: Eh…. Being involve in this project has gave me a positive attitude and it will help me to like as a Life Sciences teacher as like for instance when we are teaching topics like nutrition at school, I know that I will be able to teach it well, coz I already have something that I know of like vitamins that we get in…. in…. vegetables like carrots. We know that there's vitamin A which is more…. Which is important for people

who have problems with eyes, they can be able to…. They can be able to be healed in such way and the other thing, the spinach has a lot of iron which is more needed by our blood then these fruits that we…. that children normally buy at shops for…. That are high in cholesterol and spinach is low in cholesterol, I will be able to teach them about aa…. Such vegetables related to this garden and relate it to the topic of nutrition.

Mr Adebayo: ok, thank you. Can you elaborate on how the knowledge you have gained can be shared among the members of your family and the community?

Interviewee: Yah…. This knowledge I can be able to share it to my family and community coz I will tell them about something that I did and I can be able to tell them about positives and negatives of this project and also I can be able to advise them in terms of how to look after the garden and staff and which crops maybe they can plant when they want a particular vitamin or yeah…

Mr Adebayo: ok, what sort of empowerment can you say you have achieved by participating in this research?

Interviewee: Yah…. In this I have achieved to be like…. I know I can…. Not every time rely on people, I can be independent as well, like I know there's in terms of food and staff, I know that if maybe I can make my own garden like I have already started at res. I have made my small garden coz I know now it is important to just do your own garden instead of relying on going to the market and buy coz sometimes we don't have money as students and sometimes our families don't have money to support us. So, this research has also helped me, and I also been involved with other people and get different ideas

Mr Adebayo: ok thank you, you mentioned that you encountered some challenges like uhm…. Pests and uhm… water

Interviewee: yah…. Watering…yah

Mr Adebayo: so, do you these challenges or these problems can prevent you from doing this garden programme again or if you have a similar project in future?

Interviewee: No, these challenges won't…. they won't prevent me from doing so, instead now I know what challenges I might meet, so I will be able to overcome them coz I know like the water problem, I know that if maybe we doing a garden we must

maybe a closer tap or a closer way of getting water coz we were getting water from a far place and sometimes we get lazy go up and down and especially when the sun is hot, so, when doing a garden it is important to a place where we know we can get water easily and in terms of pests I know that I must…. When I…I… I see pest even if there's one or two or three, I must try and attend that matter immediately instead of waiting for it to be more coz when there's pests the pesticide can no longer work properly.

Mr Adebayo: ok, alright, so, uhm…. Tell me how these challenges that you have talked about, how it has made you to become, what can you…. Like two or three words like I have become….

Interviewee: Oh…. These challenges eh…. I can say they somehow made me feel like uhm…. Especially the pest one it made me feel like I'm losing but at the same time I realized that if I…, I attend this matter earlier it wouldn't be like… I wouldn't feel like I'm failing but yah… I wouldn't say that I…. I…. I can say that it encouraged me to be… to be more like what can I say…. Like to be more focused next time yeah.

Mr Adebayo: ok

Interviewee: yeah to be to take a…. yeah

Mr Adebayo: Hmm… How can this project be improved to benefits students on campus who are staying in residents?

Interviewee: Yah… as I said earlier this project if maybe the students that are staying in the university campus residents if they can be involved or maybe like the university can also give a hand on students like maybe in a room like maybe students are staying in two maybe students can get three packets of seeds that they can plant or maybe they can get a plot where they can plant their seeds and in that way I think students can benefit hey will have their to look after and whenever they need food they will know that there's somewhere where they get their food from instead of buying with money and staff. Yah they will benefit in that way.

Mr Adebayo: ok, the last question. Indigenous crops, did you plant any indigenous crops and what were your... Were your issues? What can you say about the indigenous crops in your project?

Interviewee: I cannot say we planted an indigenous crop, but maybe the mustard spinach is an indigenous crop but not exactly…. coz we only planted the spina…. mustard spinach, carrots and the beetroot.

Mr Adebayo: Mustard spinach?

Interviewee: Spinach, yeah…

Mr Adebayo: mustard?

Interviewee: yeah!

Mr Adebayo: I know spinach, I don't know which one is mustard

Interviewee: yeah, it is not like the normal one that we normal plant coz I also realized when it started growing coz it was different from the we normally get in shops even when you eat it, it taste like the…. Iyababa (meaning it's hot) it's bitter like there's more alkaline

Mr Adebayo: (laughs) that's a Zulu word. Ok, so you didn't plant any indigenous crop.

Interviewee: yeah

Mr Adebayo: why?

Interviewee: no, it's because it would take time to grow, that was our problem, coz maybe we planted madumbe….

Mr Adebayo: how many weeks were you supposed to use for planting?

Interviewee: Ah…. Eish…. Hmm... too sure but when we did our presentation, I think it was the 7th week

Mr Adebayo: ok

Interviewee: yeah

Mr Adebayo: So, is there anything you want to add ion this interview?

Interviewee: yah…. Eish… what can I say is that doing this project was really a nice experience and it made me realized that here at Varsity school is not about theory or getting practical in the lab but and also do things outside like doing our garden and it was really a nice experience even though there some challenges but I also enjoyed it.

Mr Adebayo: ok, wow that's a good way of closing, thank you very much for your time and it's been exciting interviewing you and participating in this.

APPENDIX 13

FOCUS GROUP INTERVIEW: NON-BIOLOGY PRE-SERVICE TEACHER (FG1 NBPST1)

Mr. Adebayo: Good afternoon ladies and gentlemen.

Interviewees: Good afternoon sir.

Mr. Adebayo: I welcome you to this focus group interview, it is err…in line with my PhD research titled Exploring University Community Engagement by preservice teachers to the study of the biology module. You are non-bio students I believe, Are you?

Interviewees: Yes, we are (chorus).

Mr. Adebayo: Are you living in the residence of the University?

Interviewees: Yes, we are (chorus).

Mr. Adebayo: Okay, so you're welcome to this program…to this interview, err…today is the Monday 15th of May (2017) and the time we are starting this interview is 12h18pm. Okay so welcome, so I'm gonna ask you some questions feel free to answer them, relax and as much as the information you can give it will help in…in making the research strong. Okay, how long did you do the food hmm…garden exercise…sorry err…it's a wrong question…that was the question for bio students this is non-bio students. How long have you been in this University? Let me start from the first person, how long have you been in this University?

Interviewee 1: Second year.

Mr. Adebayo: Please speak a bit louder.

Interviewee 1: This is a second.

Interviewee 2: This is my second year.

Interviewee 3: Second year student.

Interviewee 4: Second year student

Interviewee 5: Third year.

Mr. Adebayo: Thank you very much, err…has it been, how has it been feeding yourself and coping with your studies since you live in the residence, how has it been? Yes (recognizing interviewee 3)

Interviewee 3: hmm…Eish with me Mr. A I want to be honest, more especial in my first year I find it very difficult, sometimes you will found out that I can't balance my nutrition because you…err…you won't have like enough cash to buy what I have to buy you know, to balance my nutrition. So, I think it wasn't easy compare to this to my second year, last year it was kinder difficult.

Mr. Adebayo: What makes the difference in your second year?

Interviewee 3: Hmm…firstly, err…I think I managed to get funding earlier. Secondly, it's…I think I managed to…to balance my financial problems. Thirdly, hmm…I have some bio friends that say I should go to their garden and get some err…veges down there, as they have the garden.

Mr. Adebayo: (laughing) Okay thank you, yes more err…more question the question is how has it been feeding yourself and coping? Yes (recognizing interviewee 5)

Interviewee 5: Well I also have to agree with my colleague, in my first year as well was very difficult because I didn't have funding and I have …appearance and you find sometimes you need some to cook and you have to ask people around you for help. Sometimes it's uncomfortable when you're not use to ask people that I need this I need that… and always don't have enough money with you or you're just having maybe R50 or R100 and can't do much we that. But now it's much better since I have funding.

Mr. Adebayo: Okay, yes (recognizing interviewee 1)

Interviewee 1: Err…I didn't get any much difficulties because I got some friends that staying on res err…I began to new them. All the things that we did is to combine the money that we got and brought food to eat. Friends were good…there is not any…any miscommunication between us, so that why that friends combine money our allowances then we bring to buy enough food that will cover for us.

Mr. Adebayo: Okay, so without those friends, you can't be able to do it alone you can be able to survive alone feeding yourself alone?

Interviewee 1: Yes.

Mr. Adebayo: So, you needed to combine.

Interviewee 1: Yes, so that we can get our food and able to balance…

Mr. Adebayo: Okay.

Interviewee 2: Yes, I also did as my colleague just said like if there were no friends in the residence it will be difficult for me, but because of them it was easy just because we were combining the money from funding to manage to buy food, I think it is…

Mr. Adebayo: Okay, yes bra (recognizing interviewee 3)

Interviewee 3: Hmm…well for me…I wouldn't lie err…to say err…it was partly difficult err…partly easy because what made err…it to be easy err…should I say the easiest side was that err…err…as well I did have friends, I did have funding…of which at the end of the month when we suppose to get our…when we getting our allowances we would take the money go buy some food err…and then when we cook…sometimes I'll cook and my friends will cook. So, I wasn't always cooking because we had no fridge, so sometimes my friends cook, and I'll cook. Like we them sharing the things. So, I think that was the easiest side. And the harder one was that…we couldn't budget, we didn't know much about budgeting…so that I should say it affected us a lot because sometimes at the end of the month before the month end actually we will then go bankrupt and have no food because we didn't budget when we get our money so…

Mr. Adebayo: So how much if may ask, were you getting from funding per month?

Interviewee 3: In the month err…we were getting err…thousand or no it was R800.

Mr. Adebayo: R800 a month?

Interviewee 3: Yes.

Mr. Adebayo: Okay, and is this the same amount you're funded because your funding is differing, you're getting R800 a month?

Interviewee 2: R800 a month.

Mr. Adebayo: R800…okay.

Mr. Adebayo: Alright, err…how long…okay now let me ask you this question err…looking at your err… socio where which where can you class yourself socio

economically in terms of whether you're rich, you're poor, you're…how do, which where do you belong socio economically?

Interviewee 4: I think Mr. K it all goes to like individuals you know because hmm…we are hmm…I can't answer for like each and everyone here.

(Laughing)

Interviewee 4: Yes, you know your…each and everyone know his or her personal backgrounds.

Mr. Adebayo: (laughing)

Interviewee 4: I myself you Mr. K I'm…I'm poor based on my background you know, we're not taking from anywhere, so we like very we are struggling. Even though I'm not taking that will display that struggling but yes, I'll say even according to my own observations I think most of the students around the campus are really struggling, that those are my observations. Yes, so like I fall in a category of those who are struggling, who are coming from like a very…very poor backgrounds.

Mr. Adebayo: Okay thanks, yes (recognizing interviewee 2) if you can all speak.

Interviewee 2: For me like from last year it a little bit different because last year I had NSFAS then I got R828 it was difficult for me because I must buy food and I must buy clothes you see. But this year is a little bit different because I get FUNZA so…it is it easy for me now.

Mr. Adebayo: FUNZA is been.

Interviewee 2: Yes, it's been…it's R2300 you see.

Mr. Adebayo: A month?

Interviewee 2: Yes, there is a different.

Mr. Adebayo: Okay, but I'm talking of your home where from home, are you okay at home everything is fine?

(Laughing)

Interviewee 2: No like we're little bit struggling yes, we're not like we're fine.

Mr. Adebayo: Okay, yes bra (recognizing interviewee 1)

Interviewee 1: Err…Mr. Kemi at home I can say that we're not rich but at the other side we're just err…in the middle because I don't remember slept without any single piece of slice in the stomach so that's how I can classify my background with that we are not poor, we are not rich. My parents try that we eat every night, every morning we have something to eat and we have something to dress.

Mr. Adebayo: Okay, yes (recognizing interviewee 5)

Interviewee 5: Hmm…I think I agree with my colleague there I'm also in the middle class we are not rich we are not poor but as my other colleagues said there students on the campus most of us do comes from struggling backgrounds for example everybody from middle class we have depts. because I have a single mom and we are four girls and all have depts. for the University we …have to be eight. So, we don't have that money at the moment to pay our depts.

Mr. Adebayo: Okay, yes (recognizing interviewee 2)

Interviewee 3: Well, I can say err…almost one the same thing that this guys just said that err…for the fact that I've never go…go to bed without a single meal that symbolizes that I am not poor because I do have something…I do get something at home to go to bed with. And then again because I cannot afford most of the things that I want, most of the things that I always …of. Again, I can say I'm not rich so basically, I'm in the middle of…in the middle.

Mr. Adebayo: Thank, hmm…before I continue…the other gentleman just said something about clothes you buy clothes from this err…funding. So, it also affects you why do you buy clothes?

(Laughing)

Interviewee 2: Everybody needs clothes like I can't explain

Mr. Adebayo: Because you need it?

Interviewee 2: Yes, I need it, in the campus like to change.

Interviewee 4: Mr. K to…to fill a gap some of my colleagues like we have to know that like the society that we live in like expect us to do somethings…expect us to you see looking like others you know we…everyone I wanna fit in the society you know. Even though like you that my background is kinder difficulty but at least you have to look

apart like other…other students you know, so I think as much as we get in like small amount of cash from our funding we have that pressure like even like out of there I have to divide and get something even like it's a t-shirt or even if it's a trouser or something. And as you have said you mentioned the issue of hmm…the TP's, we must take from this R800 you know and get something some proper clothes that you're going to wear in your TP practical. So, you can see like the struggle how difficult it is to manage that R800 you know. And at home they not sending money because they know you have funding g and some of us we living with our grannies and understand that they earning the pension money, the others hmm…are your brothers and sisters back home that they have to care of so…can you just imagine how difficult the situation it is.

Mr. Adebayo: Some of you might be sending money home, is there anyone?

Interviewee 4: Yes, it happens Mr. K.

Mr. Adebayo: Send money home to assist.

Interviewee 5: Yes I have to send money home to my sisters for their transport and to buy clothes so that is why at the end the money that you get is not enough, if it was just for you it would be enough but knowing that there are people that you have to support especially when you're only one that is funded and your sisters and brothers might not have any money to take care of them. So, you must save money, money must be divided as my colleague just said.

Mr. Adebayo: Thank, so how long did you observe the food garden exercises with the bio students? Yes anybody.

Interviewee 2: Err…three weeks if I'm not mistaken

Interviewee 4: Yes Mr. K because of like we kinder busy as we from the group for the bio students that we grouped to. They used to WhatsApp me personally and say Amos lets go to the garden. Sometimes I'll make it because I'm kinder busy, I think I made three to four times down there to do my observations in their gardens.

Mr. Adebayo: ok, and you guys?

Interviewee 1: I think three times

Mr. Adebayo: three times...?

Interviewee 1: yes, we go two times in the gardens

Mr. Adebayo: can you speak louder?

Interviewee 2: I want the two times

Mr. Adebayo: you said, you went there two times...?

Interviewee 2: yeah, I went there two times.

Mr. Adebayo: Alright

Interviewees: (laughing)

Mr. Ad: mmm, let's go how many times have you participated in this project, how can biological participant can help this product to assist the community of students from poor background that are live in UKZN residents. Now what I'm…the question is that how this you saw today, how we can do this better so that it can help students on campus.

Interviewee 1: okay, hmm… Yes, I think Mr. K that is very big issue you know that won't take the load only to the bio students because at the end of the day the result of their garden we will put the university in good picture or better image by saying that, I mean the university as to do some contribution in making sure that this garden as wide, like bigger space… so that they can much better produce of their gardens because if as we said before that they a lot of students are struggling in the campus and I think the university also face the same dilemma in making sure that every student sleep with something, they are struggling to get us funding which is like the very big problem because we won't get all the funding as we know so I think the university as to do something to help those student like to hire agricultural expect to help this students as we know that they won't have much time to like dedicated to garden as they have studied aside I think the university have employ some people to help them in increasing planting something bigger so that they can reach a bigger product you know I think that what could be done.

Mr. Adebayo: Okay, any other…opinion?

Interviewee 5: I second the brother what he has said.

Mr. Adebayo: okay

Interviewee 1: Me too I agree with him

Mr. Adebayo: You agree with him.

Interviewee 1: The students they…the garden is for the marks is the part of academic assistance err…in University have to intervene that so that it will err…help other…that students who are struggling like there are so many students in the Universities like those who are orphanages, those who are…who are less dependent to their parents. Their parents they find it difficult to provide them err…some money so that a University must help them to build up that garden to be much bigger than it is.

Mr. Adebayo: Alright thank you, now what knowledge and skills did you gained from the bio students while observing this gardens from planting to harvesting and how can these knowledge assist you as a residence student in terms of …your nutritional challenges?...yes what knowledge and skills because you go there and you watch them sometimes, what did you picked, what did you learn while you see them doing this garden, what do you think?...yes (recognizing interviewee 4)

Interviewee 3: Okay, Mr. K I think err…as we all know like some of us we coming from different backgrounds you know and some of us we've never like hmm…get that opportunity or like we've never exposed to the situation whereby we go and do the gardening and everything you know. But hmm…after we met with bio students they took us there we saw everything ng happening in front of our eyes whereby we started by ploughing everything…the ….the nature of the soil that they picked for a specific kind of crop…like you gain that knowledge that like you know what maybe if wanna plant the spinach you have to plant the spinach in this certain time frame. If you wanna plant this, you must use these kinds of hmm…hmm…remedies to…to solve like the pest staff you know. So I think that's kind of…of knowledge that we gained, even if you wanna take this experience back home you can at least know that if I wanna plant the spinach I have to the spinach in this hmm…hmm…season and the yield maybe would take like before I yield I would take like such a long time…hmm…this is the type of soil that is suitable for this type of crop. I think those are some of the experiences that we gained from this garden.

Mr. Adebayo: Okay, hmm…what crops did they plant that you saw, what kind of crops?

Interviewee 5: Spinach, cabbage, carrots, betroth

Mr. Adebayo: Alright, hmm…thank you. What…do you think food garden can reduce poverty and in equality in South Africa?

Interviewee 5: Yes, I think it can but only on the certain extant because I can't just depend on those vegetables and all you need other nutritional value. And, it's important to know that in a country there is so much in inequality, you depend on the gardens to provide everything for us, and we also need to take an initiative to do something. So if this food garden can be done on the large scale then it can reach many people but to large extant but more skills has to be done, like I've said that you can't just depend on vegetables but you need to eat other things as well to sustain yourself. But then it's a starting point, it's a good start.

Mr. Adebayo: Okay, any other…yes (recognizing interviewee 4)

Interviewee 3: To add on Mr. K I think it can help a lot you know, more especially some of the students around the campus will take the issue specifically around the campus we find out that we don't normally go for…for vegetables you know. We just eat the…the junk and everything, I think if these such around the campus when you know…where you know that okay I will get the cabbage down there, I will get the spinach down there I think it is kind closer you know. We can at least try and balance the…the nutrition. I a larger perspective I think, in South Africa it would help a lot because you will found out that sometimes there is some food securities in…in some places whereby they are like some people who are really…really struggling to get hmm…to balance their nutrition or to get like even something to eat but if there are some…some governmental projects that hmm…that will ensure that they get and they plant they give err…those food parcels or something or those yields that they got from those err…agricultural plantations back to those people. I think they could reduce that food insecurity somewhere somehow.

Mr. Adebayo: Okay, yes, any other opinion. When you say inequality, what do you mean by inequality?

Interviewee 5: When I say inequality I mean we're living in the country where there is a gap between the rich and the poor is extremely wide, so there is people who too much and there is people who have too little which is a problem and you find out that

there are people who can distribute their worth or their food or would rather throw it away without sharing with those who have to little. For example if you look at Durban, there are so many la….hotels and so many people living on the street and you will found out that in those hotels so much food is thrown away and yet that food can be given to the people who live meters away. So that's what I mean by inequality.

Mr. Adebayo: So, the food garden cannot reduce that.

Interviewee 5: It can like they said before but only to a certain extent.

Mr. Adebayo: Okay thank you, now research has shown that the lack of adequate nutrition among the University students shows the prevalence of poverty among the students, how this project can help the feeding and nutritional students who reside on residence and help the nutritional challenges. How can this project help people who don't have food to eat?

Interviewee 2: Hmm…I feel if…if this project could be brought in a larger scale and with the err…the larger contribution of the University. I think it could err…assist err…more I think it could assist more…the …students more especially those because we are aware of that we are students we have no funding, student who have no support from home maybe to at least get something err…that amount of money from home. So, bearing in mind that they have no food and they are getting nothing from home, they are facing these challenges especially having to…to… they struggle to get food, I think. And this garden project this food garden project good can help a lot because with the right people are observing those…the production of the garden they can take the food and distribute it to…to the students in…in equal amount. And again as the question said that the research has shown that it affect the students population, I think having the garden err…we are aware that the garden produces the food that is…it produces fruit mostly fruits and vegetables if I'm right then this vegetables it mostly what we need as students because err…everybody is aware that students where we get money we go and buy food that is not benefitting mostly our bodies so we need that food that is produced there. We need that food because that food are….those crops are raw and the food we eat it tends to affects us because err…junks are no helpful in the body and then when it time that I have to be in class and participate and be active you may find that these food it adds to the…it adds to the…I don't know

how to place this but it adds to less contribution in classes with all affect it count with it, the junk we eat. But then I can…this garden could help a lot if you can.

Mr. Adebayo: Alright, yes hmm…I'm going to jump to number ten hmm…do you think the…the food gardens the knowledge can bring about in the election of freedom from the bondage of slave…hmm when we say bondage of slave we say you know we that mentality that we have to depend on people and so on and so forward. So, if you know this after gaining this skill do you think it can make you to be in your own not that I must depend on government, I must depend on people and so on and so forward.

Interviewee 5: Yes, I think it agree with the fact that it will give us a freedom from bondage of slavery because when you go to certain rural areas you will find out that there are people who they actually grow their food and they don't buy food. We can actually save money instead of buying and also many times the food that we buy sometimes what you think is healthy is not healthy because chemicals have been added to it you know and all this chemicals they keep on saying that because of the population they need to feed so that they can get chemicals and these chemical…in our lifestyle. Well, food has been wrong from the ground food that you have prepared for yourself you know that you're going to eat food that is healthy, and you don't have to depend on anyone. And sometimes people that they are poor they know that they have to work for someone and sometimes they're exploited but sometimes because they don't have food they need to eat then they will undergo the exploitation because they have skills to…to do what they can to grow food for themselves and they don't have to depend on anyone and they can free themselves from exploitation.

Mr. Adebayo: Okay, yes (recognizing interviewee 4)

Interviewee 4: I can say it will bring a freedom because if they have these skills now, they…we can crop our plants on our own without depending on buying like going to shops like. That means we will save money and do anything else, so I think yea… it brings our freedom from bondage of slave.

Interviewee 3: Yes, I also …Mr. K just add on to what they…hmm…if Mr. K you can hmm…just like look at…really in the townships and the way people live there in the rural areas you will find the big difference but because hmm…hmm…the expectations that the society want us to live you find out like they struggle more here in the suburbs in the township than back there. But in a…in a way that each and everything that we

have to get have to be out of your pocket here, if you wanna like eat in the morning it should be out of the pocket, during the day out of the pocket, during the night out of the pocket. Back there in the home you know that in the morning you can go in the garden and get some veges… and cook something quicker without like spending much…without spending what you don't have to. So I think that freedom could be…could bring that freedom in the wider society whereby we know that hmm…as I mentioned before that the food security you would know that at least I don't have to beg to get something while I have my own piece of land that I grow this, I don't have to beg at least to get some food. Just go there and…and what I wanna eat and balance my nutrition anyway.

Mr. Adebayo: Thank you, hmm…can this project bring transformation to in the socio-economic condition to the students from disadvantaged backgrounds? …We all know what is transformation right? (Laughing). Err…question eleven says can you bring the change in this condition, can it make you richer, can it make you better in terms of your socio economy?

Interviewee 5: Yes, I agree for example if I come from poor background and I know that I'm suffering if I can gain the skills to grow my own food I can actually one day make err…my own garden and actually sell that food to other people. I know that I'm selling something that is healthy and I can gain an income and I can survive with that because people needs to survive and you can able to …with it because you know when you always have some money.

Interviewee 1: Yes, err…it bring the change in socio economy because the time you have skills that err…use the different soils to ground (plant) the different food that's where you gain more information to how to use that and at the end you will find that you know how to err…ground…in that particu…in which err…place is good for what food so that you can able to plant food and transport it in bigger shops.

Mr. Adebayo: Alright thank you, hmm…when you were participating in this project what were the challenges some of the challenges that you have experienced when you were doing this project. What were the problems?

Interviewee 3: Like when we were observing.

Mr. Adebayo: Yes, when you were going there and observe, what were the challenges?

Interviewee 3: Firstly, Mr. K I think I've mentioned earlier that as we have a group chat they use to tell me that Amos we are going down there then you will find out that it is clashing with err…with my classes so I have to go to class and I miss observing you know so I think that's one of the challenges. And the second challenge is that by the time I went down there with them you find out that the tap is kinder far so…so when they go to observe they have to go and get some water to irrigate you know. Hmm…the other challenge that I've also observed from their side is that as you know Mr. K like if you have like the conditional crops you have to irrigate in the morning and latter not during the day but you find out that some of them they only come during the day, they only get some time during the day. During like 12pm at err…what do you call this thing…forum period sometimes, so it is during the day and the sun is too hot so even if you do irrigate it going to make a difference, so I think those are some of the challenges that we came across and the pests because I observed like lately, the pests were there like we closed and when went of…off by march their garden were left there and no one was irrigating, no one was taking care of the crops. So, I think those are some of the challenges that we came across.

Mr. Adebayo: Yes, any other challenge, you guys you went there three times, twice I think err…what was the challenges that you think you experienced?

Interviewee 1: There is no lot of challenges that I experienced, but the one is that err…when I went there to check that gardens…I found that there is no err…irrigation resources they just took a bucket then they just use them to irrigate their gardens. So, as you know that if you irrigate the garden you need something that can sprinkle all the gardens so that how…

Mr. Adebayo: So how can these problems be overcome; how can you deal with them so that you won't…in the future if this problem how can you overcome?

Interviewee 3: Okay, can I overcome my problems… (Laughing)…okay Mr. K to all that I mentioned and that I came across during my observation down there. I think firstly, the problem of hmm…of err…water I think there should be a tap or something that is closer to their gardens you know. And secondly to the one that err…like irrigating in the morning and later I think we as a group we supposed to have at least

two or one person that is free in the morning then the others will be free later maybe like they can make a sort of a timetable you see. Then on Monday Amos is going to irrigate in the morning then others will be going to irrigate later. Hmm…time management I think that's a timetable Mr. K as I say at least we must form a timetable. The other was the…the one that I said we…during we closed during March err… I think then there wasn't anyone who to took care of our garden. So I think in that space err…the University…the University also have to do something you know, because now currently we will be talking in a…in a perspective way whereby like the garden will be much bigger you know, I think if we went to of…if the schools are closed at least there should be someone to care of their gardens by the time we are off because we can't manage to not go home so that we can take care of the garden. So, I think University must help us somewhere somehow.

Mr. Adebayo: Okay, hmm…do you think you get any form of empowerments from participating in this project?

Interviewee 2: I think yes, I've been empowered in terms of skills. I've gained some skills to how err…how you can set up the garden, how you err…how you can set up the garden basically…like err…I got the knowledge maybe a skill like if you wanna plant if you want to plant cabbages you have to get a soil and make it a plot, the kind of the plot that is needed so I think yes I being empowered.

Mr. Adebayo: Okay, any other…what kind of empowerment can you give like a word or yea explain let me just leave you to express yourself. What kind of empowerment have you gained by participating in this study? You said you gain …what did you say?

Interviewee 2: I said like I think I gained skills and knowledge, I think the skill that I've gained is that …like in terms of the formation of plot and how you create maybe we say you have been given seeds to produce err…these little cabbage so you need to bed firstly before you put them in a plot. So, I think that's what one of skill I've gained, and then the knowledge to how to…to what is suitable for the plantation of that certain err…kind of a crop I think yea…

Mr. Adebayo: Okay, hmm…If I may ask you this question do you think you have developed the form of resilience by with this project? Resilience means the ability to adapt to tough times. Do you think you have it by observing this thing, are you strong now are you resilient if yes how? (Laughing)

Interviewee 3: Yes Mr. K I think yes we have you know because sometimes you find out that you have only one option of securing your food which makes you like kinder vulnerable to hunger at some point but now you get an option as we have the gardens down there you know. I think you can resist hunger in that way, because if get hungry as now I'm going down there to get some carrots to cook you know. I think that's the form of resilience to these problems that we're facing, yes, I think it brings an option that hmm…you don't have to kinder depend to…hunger you don't have to be vulnerable to hunger.

Mr. Adebayo: Alright, any other form.

Interviewee 5: I think as I understand the resilience that you have to be strong and accept the situation like now it has been raining it has continuously raining so imagine you're planted if it during a drought it will affects your plants. If it is too rainy it is raining constantly, it's going to affects and your crops may die you just have to accept sometimes that certain things are out of control.

Mr. Adebayo: Thank you, yes you disagree.

(Laughing)

Interviewee 4: I think we need to agree sometimes that certain things happens out of our control.

Interviewee 5: But it's raining all the time how we are going to control the rain.

Interviewee 4: We need to be resilience, we need to come with an option to resist like let say I must go to class, and it is raining, then what an option? Get an umbrella then make a plan that you're going to the class. You can't be saying you are not going to the class because I don't have a control of a rain you know. You don't have control over the rain that is happening you have made an option that you reach the point that you wanna reach right? So

Interviewee 5: But it is raining outside not inside.

Interviewee 4: Okay let's talk about rain, the rain yes, the plants when you referring to a rain and plants that means the rain is good for the plants that's why…yes too much of it but

Interviewee 5: That's why in certain areas it rains even for months and it affects the plants, that's is what I'm saying.

Interviewee 4: I understand, but when it comes to that things you need to make an option like okay how can I solve the kind of the problem you know. How can I at least make sure that my plants are sustaining in this problem?

Mr. Adebayo: So that you don't give up.

Interviewee 4: Ya so that you don't give up, you can see that hmm…I don't have the…all those who are cropping they made a plan. You can't just say I…I won't do anything my crops they like have to.

Mr. Adebayo: Okay, I think we are getting to the last question now, do you think you can share the knowledge of food garden with members of your families and communities?

Interviewee 5: Yes, I think I should share this kind of knowledge with families and communities because that's where growth begins you know. It doesn't have to come from the government or someone like a president to mention something like that or the minister. You may change start from an individual you know as other guy said from an individual to….so speaking on this food garden you can go home and tell them this is what the biology students have been doing, this is what is going to assist you. And if every person can do that if all as we are sitting here, we can do that imagine the impact that we will have. That's what.

Mr. Adebayo: Yes, any view.

Interviewee 4: Yea like I agree with her.

Mr. Adebayo: Yes, do you agree, you share with your families and communities.

Interviewee 1: Yes, I agree, as I am coming from a family where is err…has some garden to plant …so we can transfer it to…to those people who have resources to process it. I'm coming from the family who has the garden.

Mr. Adebayo: Okay, yes, my brother. (Recognizing interviewee 2)

Interviewee 2: I think yes Mr. Kemi err…I can share the knowledge and skills that I've gained there err…to my family and…to my err…to my community mostly because I

think there are people out there who are not enlighten to how to conduct the gardens, to how to extract from stretch a garden and what is needed for a garden to…to be successful for the crops especially. So, I think yes, I can share it with my family and community.

Mr. Adebayo: Okay, any other view.

Interviewee 3: It's just similar Mr. K I also agree Mr. K.

Mr. Adebayo: Okay, so is anything you want to say before we close this err…segment.

(Laughing)

Interviewee 5: Yes, I just I want to say I think this been very…I'm glad of being the part of this research of yours…because I've never actually thought there is something by this know about food gardens and I know services in school and I've never thought the context of the University actually doing something like this it help students on campus that was not on my mind. But I think it has planted a seed on us to think and see and move on with the future.

Mr. Adebayo: Thank you, yes (recognizing interviewee 3)

Interviewee 3: (Laughing) this is the reason I wanna always talk first because…

(Laughing)

Interviewee 3: She said exactly what I wanted to say.

Mr. Adebayo: It's fine you can say I'm sure…

(Laughing)

Interviewee 3: We might like just to have a different voice otherwise…

(Laughing)

Interviewee 3: Anyway Mr. K I just wanna say thank you Mr. K for this opportunity even though we som…sometimes we like kinder ran away kinder busy and you know but I think I really helped us you know in a way we…we came out with something. We can now at least go out there and tell other people by something that we observed and see like you know what you can make this kinder garden for this kinder reason rather than hmm…before you find out that back home as we all said that we're coming from

like families that are like taking from nowhere so I think we now have another option like you say okay we…we going home at least guys as we take care from home let's not expect someone to do something for us. We can get in a garden as a family plant something that will help us to secure our food you know. So, I think it really helped us a lot some of us.

Mr. Adebayo: Okay thank you, any other...view, any other opinion.

Interviewee 2: Err…just…I can round up on what Amos just said that it's only the skills and knowledge we obtained and I think it…it's all on us now to go there and share with our community and families so…that's all I can say .

Mr. Adebayo: Thank you for rounding up.

(Laughing)

Mr. Adebayo: Err…it's been a good time with you guys err…this is the longest interview session I've ever done.

(Laughing)

Mr. Adebayo: Well it's very interesting because it keeps…you guys keep talking and you know we were flowing now I'm really excited.

(Laughing)

Mr. Adebayo: I think we spent about err…49 minutes but err…thank you very much for making time and I wish you all the best thank you.

APPENDIX 14

INDIVDUAL INTERVIEW: NON-BIOLOGY PRE-SERVICE TEACHER (NBPST1)

Mr Adebayo: Good day

Interviewee: good day Sir

Mr Adebayo: how are you sir?

Interviewee: I'm fine

Mr Adebayo: I'm well, my name is Mr Adebayo, I'm conducting this research exploring university community engagement by pre-service teachers through the study of biology module and hmm… this is an individual interview for students who are residing on res and non-bio students hmm… who have participated in the focus group interview session in the couple of weeks ago, on the same project. You have been selected as the member of one of the groups, the two groups. So, now hmm…. it is 20/05/2017 and the time is 12:35pm, so I just have some questions for you just too…. as a follow up to our…. our focus group. Ah…you narrated your experiences of being self-reliance through the practicing food gardening hmm…. can you tell me what...? What… what do you mean by being self-reliant if you are self-reliant?

Interviewee: ok, number one, to be self-reliant eh… I think is to rely in yourself eh… to have everything around you, eh… if you want something just eh… do not even contact anyone but eh…. rely on you just have everything around you and eh…. to accomplish everything that you want to accomplish.

Mr Adebayo: ok. So, through this gardening now what kind of…. so, it has taught you to be that?

Interviewee: …. yes, to be self-reliant

Mr Adebayo: Yea what was your best moments in this project, at those times or times you like?

Interviewee: Yea we had fun just to see everyone getting their hands dirty and eh… planting, irrigating some crops and eh… yea I had fun and the best moments is when they teach me what is this, the show me why it has now grown so fast, why did they choose the location why… of their garden. Yea we had fun just to see my peers

teaching me what I didn't know about the garden so, that was my best moment, yea there were things that I didn't know about the garden so yeah.

Mr Adebayo: ok, how far do you think food gardening can go to reduce poverty and inequality among students from previously disadvantaged homes who are residing in the university residents?

Interviewee: garden can far since the weather condition allows us to plant. It can continue as far as it can and if eh… people avail themselves eh… and take that initiative to plant and to grow some crops it can go far as they wish…

Mr Adebayo: ok, so go far what sense… what reach?

Interviewee: Maybe throughout the year, it can go throughout the year and even the following year the other students that are planting in the following year they can continue with the gardens.

Mr Adebayo: So, how it helps the students on res?

Interviewee: Eh…. maybe we now…. For especially those come from the poor backgrounds they don't have to buy food since they don't even have enough money to buy food, but they can just go to the garden and harvest the plants and crops, yeah.

Mr Adebayo: ok, can you explain further how getting involve in this research has affected your life?

Interviewee: Yeah, before I entered to the research eh… there are things that I didn't know eh... there are people that I met through the research the process of the research and now I… I… even I can even say I would like to further my studies also, I would like to see myself maybe one day doing a research and I didn't even know that you can even do research through us, I thought it just for people that are just there not for us (laughs) so to be involved it's such a pleasure it's affected me good yea.

Mr Adebayo: ok thanks. Hmm… can you elaborate how the knowledge you have gained can be shared among the members of your family and community?

Interviewee: ok jar when going back to home maybe hmm…. I will like my granny starting maybe a garden I will assist, and I will share eh… what she must plant and what season of the year and eh… what kind of crops that we really, really need eh… maybe like carrot.

Mr Adebayo: … and the community?

Interviewee: eh… there are community gardens that are just for…..everyone that is allowed to plant so even if going back to home I will like maybe to take a part just to be involved and just to be involved to what they are doing maybe just start planting for my family and also with the community members at large.

Mr Adebayo: so, what sort of empowerment have you achieved in this research?

Interviewee: ok, maybe to add what I have said that I was inspired through this research eh…. maybe yeah, I'm really empowered (laughs) maybe one day I believe that through my academic maybe one day I will be sitting on your chair conducting a research yeah, maybe yeah, I'm empowered.

Mr Adebayo: What kind of research are you looking for to conduct?

Interviewee: (laughs) yeah it can be a research that involves more of the youth since I'm still young I would like to involve more of the youth. Maybe for now I'm not specifically what can maybe the topic but if involves the youth and children to be the research….

Mr Adebayo: … that can help?

Interviewee: Yea….

Mr Adebayo: the youth, the children

Interviewee: ok, now another question, the last one, it says what change or transformation do you expect to come out of this project?

Interviewee: ok since it was the project from the gardens and nutrition maybe…

Mr Adebayo: in relation with the students on res….

Interviewee: yeah… maybe eh… from this research maybe we'll see one day eh… maybe the gardens for the students that lives in residents the large gardens basically for resident's students so yeah if it succeeds in that way maybe we'll see.

Mr Adebayo: it can be garden…

Interviewee: yes, it can be used for the…. the plant maybe students residing on residents they can use them so the...the … yeah.

Mr Adebayo: … the crops for themselves….

Interviewee: yeah

Mr Adebayo: ok alright thank you we have come to the end of the interview. It's eh… this is 12:41pm and hmm… I thank you for the time.

APPENDIX 15

Exploring university-community engagement by pre-service science teachers through the study of a Biology module.

PhD research work of Mr Adebayo O.A

Reflective Journal (Food Garden)

Name: [redacted]

Group: ___1_____

Date: May 2017

Type: Pre-service Science Teacher (PSST)

1. What benefits do you think this exercise will achieve in terms of engaging the residence campus student community?

It will benefit the residence students by them learning indigenous ways of starting food gardens and them getting to eat fresh and healthy vitamins from these vegetables.

2. What has been the challenges you have had and how did you overcome them?

Our garden was under trees so they blocked sunlight and the dead leaves fell on top of our crops they attracted pests & also our third crop which was amaranthus didn't grow, so we planted Madumbis instead they grew, we cleaned our garden daily & watered it.

3. How has teaching and enlightening the non-Bio student who is observing your plot been?

It has been very interesting because they also have their own knowledge concerning gardening indigenously.

4. Do you think that this project can influence the nutritional well-being of the non –Bio students who come from poor families in the university? Can it meet their nutritional needs?

Yes it will influence them because some of them have certain diseases which need them to eat healthy fresh vegetables.

5. Do you think the residence student's strength and resilience over food insecurity/lack of adequate food can improve through this food gardening?

It can improve because with these gardens they will have easy access to healthy food (Vegetables).

6. Can garden project reduce poverty and bring about empowerment south Africa students residing in the residence?

Yes it can reduce poverty & bring empowerment, because when gardening it teaches you too many things, when they have harvested their crops they can eat ~~with~~ it and even sell some to make some pocket money.

7. What Indigenous crop did you plant and what is the nutritional value to students residing on university residence?

* Carrots which is rich in vitamic A- it helps people with night blindness, it offers healthy eyes overally.
* Spinach rich in vitamin E also helps in healthy eyes
* Madumbis - rich in vitamin B and minerals Selenium & Zinc for healthy eyes also.

8. Mention the other crops that you have planted and their nutritional benefits? If not planted, why?

We only planted the 3 indigenous crops I have mentioned above.

9. Research indicates that Community Engagement by students (like you) allows them to have experiential learning and it also provides solutions to the community's requirements. Do you think this garden project has given you experiential learning and provided solutions to the students' community's needs? Please explain.

Yes it has provided me with experiential learning because in my neighbourhood no one plants food we usually buy vegetables from shops, and now I know how to plant vegetables & its more efficient because it doesn't waste money & its healthy.

10. What attitude or impression have you developed after completing this exercise? How do you feel? Explain briefly.

I have developed persistence, because at times I felt we are not doing right but we were patient and working hard at the end we made it. It felt very good to see something you planted with your own hands grow.

11. Any other comment you may want to add?

If this project could be compulsory for every student that does biological sciences, it could help many people in future. It was a very nice & interesting experience.

APPENDIX 16

Exploring university- community engagement by pre-service science teachers through the study of a Biology module.

PhD research work of Mr Adebayo O.A

Nutrition Project: Food Garden

PSST Portfolio

Name: [redacted]

Group: 3

Date: 17 May 2017

Content of Portfolio for BIO students:

1. Schedule of Events with pictures as evidence:

Planning

A garden dimension are as follows the breath is 1,8m and the length is 2,73m with a rectangular shape located on a very gentle slope exposed to the sunlight, with the three indigenous crops which are carrots, beetroot and spinach which are favourable/ tolerant to the exposure to the sunlight, the garden was planned that it would be maintained by being monitored by all the group members daily for watering, controlling of pest and making sure that the crops were not damaged by anything since there was no fence

Soil Preparation

1

- the place was found uncultivated with many of weeds, the initiative was taken by removing all the unwanted weeds then preparing the soil for the ploughing of the crops and by adding the natural fertiliser (the plant remains decomposed), which the soil is mixed with natural fertiliser then left for some time for the soil to be readily prepared for the cultivation of the selected crops. After removing foreign particles such stones, we then started to mix up the soil using spade and folk and applied compost as well.

Soil preparation in progress

Applying compost on he soil

Weeding

On the point of weeds, we firstly removed the weeds including the grass cover by uprooting them with our bare hands. We the used the tools later (hoe and spade)

Irrigation

To irrigate our garden for the survival of the crops we had to walk a distance to fetch water every day, because the tap was not in the same spot where our gardens were. Sometimes we used buckets but most of the time we used the bin that has wheels and we did that to reduce many trips to fetch water and the bin could carry more than enough water for adequate irrigation

Sometimes we used buckets to water our crops

Watering using a bin as a water container

Pest control

The pest control which will be used is the wood ashes which will kill all the pesticides endangering the crops

Harvesting

During the time for the garden assessment the crop that was ready for harvest was the spinach, the other two types of crops were not ready for harvest we were still waiting for them to be ready. Therefore, we did not harvest the crops.

2. Explanation of the suitability of the crops for the target group (Students from poor socioeconomic background who live in the university campus residences) i.e. their nutritional needs to the target group.
   - The students from poor socioeconomic backgrounds can benefit a lot from these garden project, especially since the crops that are grown in this garden are highly rich in nutrition and they contain almost all the nutrients that are needed by the body. For example, carrot can boost a person's cognitive ability and restore vision, whereas beetroot has been praised by many experts and prescribed by many doctors for blood regulation and cancer, cardiovascular diseases prevention. On the other hand, the spinach is regarded as one of the crops that helps lowering high blood pressure since it contains iron and many other vitamins and minerals.

- The garden can help build student's self-reliance and resilience. It can meet their nutritional needs.

3. **Challenges Experienced:**
   - Watering the garden was not an easy task especially since it was done two times a day.
4. **How the challenges were overcome:**

   We made a roster which in turn brought up some convenience in terms of watering.
5. **Interesting Moments:**
   - The first time were happy about our garden; it was the time when we first saw the crops shooting out from the soil after a week they had been ploughed.
   - The second time it was when we saw our crops growing up, increasing in size and looked very fresh and greener.
   - Lastly were so happy when our lecturer told us that our garden was the best.
6. **Garden plan:** The garden was designed in a rectangular shape and was divided into three sections to accommodate three different types of crops (Spinach, beetroot and carrots. It was in a sunny area for the survival of the crops since they require sunlight for their growth. There were passages between the section for watering purposes. It was demarcated with timbers as barriers around the garden, that made people not easily step on our gardens.
7. Your views about the role of students in university community engagement.

The students that were part of this garden project needs to engage other students
From the university who were not part of the garden project and share their experiences with them and clearly teach them about the importance of having your own garden.
Students will explore and participate in the concept of "community food security" through community engagement and learning gardens

5

8. Views about the role of Life Sciences teachers in enhancing the community resilience through food gardening:

Teachers need to take a full responsibility to teach their learners about the gardens. They need to teach them the strategies of how to go about doing a garden so that learners can put that in practice in their communities.
Teachers need to make sure scaffold and monitor when they are doing their gardens.
Teachers needs to provide adequate materials or tools for learners to do their gardens and in that way learners can enhanced to do garden even in their communities and in turn building community resilience

9. **Duty list:**

- [redacted] were responsible for the ploughing and maintaining the crops that there were no weeds growing which will outcompete the growing of the desirable crops.
- [redacted] were responsible for the watering of the crops and maintaining pests

Research Portfolio

FOOD GARDENING

7

(/)

Spinach: Health Benefits, Uses, Precautions

Written by Megan Ware RDN LD (/authors/megan-ware-rdn-ld)

Knowledge center (/knowledge-center)

Last updated: Sun 13 September 2015

Popeye was definitely on to something. Spinach is a super food loaded with tons of nutrients in a low calorie package.

Dark leafy greens like spinach are important for skin and hair, bone health, and provide protein, iron, vitamins (/articles/195878.php) and minerals.

The possible health benefits of consuming spinach include improving blood glucose control in diabetics, lowering the risk of cancer (/info/cancer-oncology/), lowering blood pressure (/articles/270644.php), improving bone health, lowering the risk of developing asthma (/info/asthma/) and more.

This MNT Knowledge Center article is part of a collection of features on the health benefits of popular foods (/articles/269143.php), all written and reviewed by our qualified nutritionist.

Possible health benefits of spinach

Diabetes management: spinach contains an antioxidant (/articles/301506.php) known as alpha-lipoic acid, which has been shown to lower glucose levels, increase insulin (/info/diabetes/what-is-insulin.php) sensitivity and prevent oxidative stress-induced changes in patients with diabetes (/info/diabetes/). Studies on alpha-lipoic acid have also shown decreases in peripheral neuropathy (/articles/147963.php) and/or autonomic neuropathy in diabetics.[1]

Of note, most studies have used intra-venous alpha-lipoic acid and it is unsure whether oral supplementation would elicit the same benefits.[1]

Cancer prevention: Spinach and other green vegetables contain chlorophyll which has shown to be effective at blocking the carcinogenic effects of heterocyclic amines which are generated when grilling foods at a high temperature.[2]

Asthma prevention: The risks for developing asthma are lower in people who consume a high amount of certain nutrients. One of these nutrients is beta-carotene (/articles/252758.php), of which spinach is an excellent source. Apricots, broccoli, cantaloupe, pumpkin (/articles/279610.php) and carrots are also rich sources of beta-carotene.[3]

Lowering blood pressure: because of its high potassium (/articles/287212.php) content, spinach is recommended to those with high blood pressure (/articles/159283.php) to negate the effects of sodium in the body. A low potassium intake may be just as big of a risk factor in developing high blood pressure as a high sodium intake.[4]

Other high potassium foods include potatoes, tomatoes, lima beans and oranges.

Bone health: Low intakes of vitamin K have been associated with a higher risk for bone fracture (/articles/173312.php). Adequate vitamin K consumption is important for good health, as it acts as a modifier of bone matrix proteins, improves calcium (/articles/248958.php) absorption and may reduce urinary excretion of calcium.[5]

Promotes regularity: Spinach is high in fiber and water content, both of which help to prevent constipation (/articles/150322.php) and promote a healthy digestive tract.

Healthy skin and hair: Spinach is high in vitamin A, which is necessary for sebum production to keep hair moisturized. Vitamin A is also necessary for the growth of all bodily tissues, including skin and hair. Spinach and other leafy greens high in vitamin C are imperative for the building and maintenance of collagen (/articles/262881.php), which provides structure to skin and hair.

Iron-deficiency is a common cause of hair loss (/articles/70957.php), which can be prevented by an adequate intake of iron-rich foods, like spinach.

Nutritional breakdown of spinach

One cup of raw spinach contains 27 calories (/articles/245588.php), 0.86 grams of protein, 30 milligrams of calcium, 0.81 grams of iron, 24 milligrams of magnesium (/articles/286839.php), 167 milligrams of potassium, 2813 IUs of Vitamin A and 58 micrograms of folate (/articles/287677.php).

Most of the calories in spinach come from protein.

Spinach is one of the best sources of dietary potassium, weighing in at 839mg per cup (cooked). To compare, one cup of banana (/articles/271157.php) has about 539mg of potassium.

A lack of iron in your diet can effect how efficiently your body uses energy. Spinach is a great non-heme source of iron, along with lentils, tuna and eggs.

Spinach contains approximately 250mg of calcium per cup (cooked), however it is less easily absorbed than calcium from sources like dairy products. Spinach has a high oxalate content, which binds to calcium deeming it unavailable for use in our bodies.

When it's all said and done, our bodies can only absorb about 5% of the calcium in spinach (about 12.5mg per cup) whereas the absorption rate from calcium in milk is about 28% (300mg of calcium in one cup of milk at a bioavailability level of 28% would provide 84 mg per cup).

Spinach is also one of the best sources of dietary magnesium, which is necessary for energy metabolism, maintaining muscle and nerve function, heart rhythm, a healthy immune system and maintaining blood pressure. Magnesium also plays a part in hundreds more biochemical reactions that occur in the body.

Those with digestive disorders, alcoholic, older adults and individuals taking medications such as antibiotics (/articles/10278.php) and diuretics are more likely to have a magnesium deficiency and should consume more leafy greens.

The Health Benefits of Carrots

Consuming Carrots are known to be good for the overall health and specially organs like the skin, eyes, digestive system and teeth. Carrot is used in several Juice Therapy Remedies for diseases. Given below are some benefits of this Vegetable.

- Carrots are rich in Beta carotene which is a powerful antioxidant which helps in maintaining a healthy skin and also keep one away from many diseases.
- Carrots are rich in alkaline elements which purify and revitalize the blood.
- They balance the acid alkaline ratio in the body.
- Carrots have Potassium in it which helps to balance the high levels of sodium associated with hypertension and keeps blood pressure under control.
- The high soluble fibre content in carrot, it reduces cholesterol by binding LDL, the bad cholesterol, and also increases the HDL which helps in reducing blood clots and heart diseases.
- Carrots are great for dental health as they kill harmful germs in the mouth and prevent tooth decay.
- Carrots aid digestion by increasing saliva and supplying the minerals, vitamins and enzymes required for it.
- Regular consumption of carrots helps in preventing gastric ulcers and digestive disorders.
- Raw carrots are used as a home remedy for treating worms in children.
- Raw or grated carrots can be used for wounds, cuts and inflammation.
- Carrots are rich in Carotenoids which are beneficial to blood sugar regulation.
- Carrots contain a phyto-nutrient called falcarinol which helps in promoting colon health and a reducing the risk of cancers.
- Consuming carrots regularly are known to improve the quality of breast milk in mothers.
- It also helps in increasing the menstrual flow.
- Consuming Carrots regularly can improve the appearance of skin, hair, nails etc and also improve eyes health.

Five Health Benefits of Beetroot

By: Sandeep Godiyal, Natural News

Beetroot, also often known as the beet, is a root vegetable that has been consumed since ancient times. Even the ancient Romans and Greeks thought beetroot had vitamins and minerals. In fact, today's studies prove that not only are they loaded with beneficial nutrients, but beetroot is an amazing way to ensure that a person stays healthy.

A root vegetable, the reddish and bulbous portion of the beetroot is grown underground while its leafy top is seen above the ground. It grows in both tropical and temperate areas, and takes about two months to reach maturity. Though the plants have been cultivated for thousands of years due to their dietary benefits, it is only recently that their many health benefits have been explored.

1. Beetroot enhances sex

The ancient Romans prized beetroot as an aphrodisiac and raised them as such. Today's science supports this Roman practice. Researchers have found that beets contain high amounts of boron, an element that relates directly to the production of sex hormones in humans.

2. Beetroot equalizes mental health

Betaine, the same component that is used by practitioners to treat depression using certain methods, is found in beetroot. Another great element that beetroot contains is tryptophan, which has been shown to create a sense of well-being while also relaxing the mind. They are also a great way to lower blood pressure, which can help offset the effects of stress on the body.

3. Beetroot increases energy levels

Because the sugar contained in beetroot is released slowly throughout the body, even though the sugar levels are high, they help maintain steady energy levels. When compared to foods such as chocolate whose sugars are processed quickly by the body, beetroot, which is also low in calories, makes its energy boost last a great deal longer.

4. Beetroot is high in vitamins and minerals

Because they are high in vitamin B and iron, beetroot is especially beneficial to those women who are pregnant. Vitamin B and iron are necessary for the growth of new cells as well as replenishing the iron levels that often dip at this time of life. In addition, beetroot is high in the following vitamins and minerals: fiber, phosphorus, potassium, folic acid, beta-carotene, vitamin A, magnesium, vitamin C and betacyanin.

5. Beetroot helps cleanse the body

Beetroot works to cleanse and clarify the liver. It can also purify the blood and has been shown to help prevent some forms of cancer. Eating beetroot can also indicate whether a person has low amounts of stomach acid. This is shown if their urine turns pink.

Adding beetroot to the diet is easy. Many people simply add beetroot that is mashed and cooked to their smoothies. Another way to prepare it is by thinly slicing it before drizzling with olive oil and broiling it.

Sources for this article include:

http://www.bbcgoodfood.com

http://www.herbwisdom.com

http://www.whfoods.com

http://science.naturalnews.com

APPENDIX 17

Exploring university community engagement by pre-service science teachers through the study of a Biology module.

PhD research work of Mr Adebayo O.A

Reflective Journal (Food Garden)

Name: [redacted]

Group: ___2_____

Date: May 2017

Type: Non-Biology Pre-service Teacher (NBPST)

1. Having been observing and learning from the garden project; do you think this project can positively influence the nutritional well-being of students living on university campus residences who come from low socio-economic background? Explain your answer.

Yes. Many students are lacking when it comes to feeding others eat junk food which is not healthy at all. And some go to bed on an empty stomach. A food garden will produce healthy vegetables that students need to keep healthy. In this way they will even motivate others to plants and harvest

2. Have you ever felt like giving up while participating in this project? Yes or No. If yes, why? And if no why?

Yes! As a student living off-campus, it is not always easy to find time to come to the garden which is on ~~co~~ campus for monitoring. I have also had a hectic semester, whereby many assignments were due around the same time so, this brought about divided attention

3. Can the situation of the community of students living on residence who struggle with feeding be transformed through this initiative of the BIO students'/BIO module? Explain?

Yes! All students need to see this as a good initiative, and not just leave it to the Biology students Biology students should be seen as the leaders or people who begun this project, as a precedence for the rest. We all need to learn gardening skills so that we can contribute greatly to this initiative

4. Do you think you have developed some form of resilience (ability to endure tough times) through observing the food garden project of the BIO 310 students? Please explain.

Yes! I have learnt during this time that planting needs patience and understanding; in order for it to become a success. I noticed that some of the vegetables had been eaten by pests. But this did not stop me from continuing to monitor the food garden.

5. What knowledge and skills did you observe from this food garden experience?

The skills of gardening, dealing with different types of plants; knowing how to clear a place in preparation for gardening; how to deal with pests; I learnt which soil is best suited for or fertile for planting.

6. Do you think food gardens; the knowledge and skills can bring about intellectual freedom from the bondage of slavery? Briefly describe your views.

Yes. Many of us have been trained to depend on people or the government for our survival. However food gardens provide people with skills that enable them to generate income for themselves to support their families.

7. Can this project bring change/transformation in the socio-economic conditions of students from disadvantaged background? Explain.

Yes. If struggling students learn the skills of this food gardening, they will be able to transfer these skills back to their homes and villages to uplift their communities, to put an end to starvation/malnutrition.

8. What kind of empowerment (if any) have you gained from participating in this study? Please elaborate.

I have learnt that I do not have to keep buying vegetables from supermarkets which have been genetically engineered, when I can grow my own which are healthy and contribute to sustainable development.

9. Any other comment you may want to add?

I have never thought about having food gardens in the university, But I now know what a great impact they can have on students from disadvantaged backgrounds. I believe this project should spread throughout the country to reach as many students as possible to reduce starvation/malnutrition. RQ1.7

RQ2.5

APPENDIX 18

PROBLEMS
OF EDUCATION
IN THE 21st CENTURY
Vol. 77, No. 1, 2019
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CREATING A DECOLONISED CURRICULUM TO ADDRESS FOOD INSECURITY AMONG UNIVERSITY STUDENTS

Oluwakemi Ayodeji Adebayo, Ronicka Mudaly
University of KwaZulu-Natal, South Africa
E-mail: kadebayo_fds@yahoo.com, mudalyr@ukzn.ac.za

Abstract

A plethora of debates about intellectual imagination regarding decolonised curriculum development has dominated the South African higher education discourses. There is a need to purge Africa of the marginalisation that has been perpetuated by curricula established during the past century. The aim of this research was to add a practical dimension to this discourse, by altering traditional curriculum activities in a biology module, in order to address the issue of food insecurity among university students. In this qualitative inquiry, the following questions were asked: "How can pre-service teachers engage with decolonised curricular activities, in order to address food insecurity among students?" and "What are the consequences of pre-service teachers' engagement with decolonised curricular activities which respond to food insecurity?" Thirty-six pre-service biology teachers and 12 non-biology university students were purposively selected to participate in a food gardening activity. Data were generated using individual interviews, focus group interviews and the development of portfolios. Findings revealed that pre-service teachers' consciousness of the social reality of food insecure students was raised, and their feelings of empowerment to enable others, and themselves, to become self-reliant, were enhanced through decolonised curricular activities. This is significant because it signalled a freeing of pre-service teachers from material and intellectual shackles which is critical to decolonised thought and action. This research has implications for higher education science teacher education modules, which can incorporate science from Western and indigenous sources, to create transformed curricula which are socially responsive and reflect epistemic justice.

Keywords: *decolonised curriculum, food gardening, indigenous knowledge, qualitative methodology, self-reliance, transformation.*

Introduction

While leading education analysts hotly debate the conceptualisation of curriculum, decolonisation, democratic curricula, epistemicide and anti-colonial struggles, the real, ongoing suffering of some university students whose access to food, a fundamental resource, is impeded. Students starve while researchers and analysts theorise about truths, power, knowledge, values, and so on. Literature is replete with evidence that lack of social capital, epistemological and financial deprivation among university students have influenced their study outcomes negatively (Van Zyl, 2015). Financial deprivation has resulted in students being unable to access affordable housing (Dominguez-Whitehead, 2015). Many of the universities which do provide residence halls exclude the provision of meals and this makes students, especially those who are less privileged, food insecure. Within the South African context, this phenomenon is indicative of food insecurity and starvation in the broader society. Kumo, Omilola and Minsat (2015), who conducted a survey, revealed that people in 23% of the homes could not get enough food to eat while people in 13% of homes had experienced starvation. These researchers conceded that food security remains a challenge in South Africa despite various government interventions to ease poverty.

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APPENDIX 19

Angela Bryan & Associates

6 Martin Crescent
Westville

Date: 11 November 2019

To whom it may concern

This is to certify that the Doctoral thesis : Explaining University – Community Engagement by Pre-Service Science Teachers Through the Study of a Biology Module written by Oluwakemi Ayodeji Adebayo has been edited by me for language.

Please contact me should you require any further information.

Kind Regards

Angela Bryan

angelakirbybryan@gmail.com

0832983312

APPENDIX 20

Exploring University-Community Engagement by Pre-Service Science Teachers through the Study of a Biology Module

ORIGINALITY REPORT

11%	6%	3%	8%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

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3	repository.up.ac.za Internet Source	<1%
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9	Submitted to Mancosa	